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ERRATA—VOLUME XIII.

Page 59, line 8 from foot, for "morality" read "mortality."

Page 109, line 16 from foot, for "offspsing" read "offspring."

Page 125, last two lines transposed.

Page 270, lines 18, 23, 29, for "Havant" read "Lavant;" and line 29, for "spring" read "springs."

Page 271, line 12 from foot, for "well" read "water."

Page 373, line 17, for "statement" read "statements."

PREFACE.

THE present Volume contains a record of the proceedings of the Institute for 1893, and includes papers read at the Sessional Meetings and the discussions upon them; a series of Special Lectures on "The Sanitation of Industries;" and two of the Lectures given in the course for Sanitary Officers, which have been frequently asked for by Members and Associates.

A record of the progress of the Library and Examinations of the Institute is also given.

The Committee have incorporated in the Volume an Illustrated List of the Exhibits to which Medals and Certificates have been awarded at the Exhibitions held since the incorporation of the Institute.

The Volume being published before the Annual Meeting cannot, of course, contain the Annual Report, but this will be sent to the Members in the Quarterly Journal of the Institute, which the Council have decided to publish in future in place of the Annual Volume of Transactions.

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The next Congress and Exhibition will be held at Liverpool, September 24th to 29th, 1894.

LIGHT, AIR, AND FOG.

By G. V. POORE, M.D., F.R.C.P.

Read at the Sessional Meeting, February 8th, 1893.

In considering the climatological conditions which are favourable to the formation of fog in London one cannot do better than examine actual facts; and, therefore, I have recourse to the returns to the Registrar-General for the week ending December 26th, 1891, for the purpose of making a critical study of the notable fog of Christmas, 1891, its cause and consequences.

In order that fog may be formed, the air must be laden with *moisture*, and consequently in London the winds which bring the fog are those which come from the eastward, over the sea and up the estuary of the Thames. Fogs are necessarily phenomena which depend upon *stillness* of the air, for they are quickly dissipated by even a moderate breeze. In order that the moisture-laden air may precipitate its moisture in the form of fog it needs to be *chilled*, and, therefore, our winter fogs only occur in cold weather. December 20th, 1891, at Greenwich was a clear frosty day with very light air from the north-east. On the following day the wind became due east and dropped to a dead calm, and then commenced a dense fog which continued till the evening of Christmas Day, when the wind shifted to the south-west and the frost and fog came to an end.

In the week ending December 26th six days were frosty, and a dense fog continued for the greater part of five days. The air was almost saturated with moisture. The mean daily value of temperature was 10·2 degrees *below* the average, and amounted to 29·1 degrees only. Out of fifty-four hours during which the sun was above the horizon, sunshine was registered at Greenwich during 4·7 hours only, and the sum of the horizontal movement of the air for the week amounted to 784 miles, or 1,341 miles below the average.

The barometer stood at 30·49 inches at the beginning of the week and gradually fell to 29·7 at its close. These quantities are, be it remembered, the result of observations at Greenwich, and taken about 150 feet above the mean sea-level. Meteorological observations in the centre of London are not recorded with any systematic care, but we may feel tolerably sure that the temperature in London was slightly higher than at

Greenwich; that even less sunshine was recorded, and that the rate of movement of the air was even less and amounted to downright stagnation.

The characteristics of the air during a fog are, then, *darkness, coldness, dampness,* and *stagnation.* It appears probable (although I know of no exact observations) that the mobility of the air and the diffusibility of its component gases is diminished during a fog. One of the often-recorded phenomena of a fog is the way in which it remains stationary in banks, and with exact limits (forming real pillars of cloud), for hours at a time; and one must take it for granted that the products of respiration and combustion are not easily removed in such circumstances, but remain to irritate, and perhaps to poison, those who are surrounded by such envelopes of vapour. It is this stagnation of the air which, I believe, constitutes one of the great dangers of a fog. In estimating the effect that a fog has upon the health and comfort of those who are immersed in it, a very important matter is its *duration.* All fogs, and especially London fogs, which are laden with irritative and infective particles, are very trying to sufferers from lung disease, especially those afflicted with chronic bronchitis, and the danger to these persons may be looked upon as proportioned to the length of time they are exposed to adverse circumstances. If the fog, after a few hour's duration, clears up, the lungs get rid of the irritating matter, respiration becomes normal again, and the patient is able to withstand a second bout of fog when it returns; but if a fog continues for a few days instead of a few hours, there is no respite, and the patient succumbs. I have elsewhere compared Londoners in a fog to fish in a bowl, who suffer from the neglect of their owner to change the water; and it is evident that the longer the change be delayed, the more unfitted the water becomes for the respiration of the fish, and the greater is the danger. So the danger of a fog increases with its duration, for not only do the dwellers in it get no respite with which to obtain, as it were, a new lease of life by even a few gasps in the fresh air; but the dense fog-bank which weighs upon them gets hourly fouler and fouler from the products of combustion and the smoke (a result of non-combustion) from thousands of chimneys and the respiratory and other impurities from millions of men and animals. A very noteworthy feature of the fog of Christmas, 1891, was its duration: it began on Monday evening, and lasted, in a very dense form and without intermission, until Friday night; so that the time during which the Londoners had to endure this weather—this mixture of coldness, dampness, foulness, and stagnation—was close upon a hundred hours.

When we come to consider what effect this long-continued fog had upon the health of London we find that we have many facts to take into consideration before we can arrive at any conclusion. The effect of cold and fog upon the death-rate is produced almost immediately because there is always a large number of sufferers from chronic maladies who are ripe for departure so soon as the first adverse circumstance arrives to overtax their feeble powers. Of course there are many others who do not die at once, but whose condition is so aggravated by the fog that they succumb in a few weeks or so. When fog and cold set in on a Monday some of the results of it would certainly appear in the death-returns furnished to the Registrar-General on the following Saturday night, but, as in this particular week Christmas Day fell upon a Friday, the work of Registration was upset, and many of the deaths occurring in the week, ending December 26th, were not registered until the following week, ending January 2nd. It thus follows that in order to estimate the effects of the fog we must take the deaths occurring in the *fortnight*, ending January 2nd, and in this way we eliminate the disturbing influence of Christmas.

The estimated average number of deaths for the weeks ending December 26th, 1891, and January 2nd, 1892, respectively, is stated by the Registrar-General to be 1,813 and 1,915, giving a total of 3,728 for the fortnight. The actual number of deaths registered in these two weeks was 1,771 and 3,399, giving a total of 5,170 for the fortnight, or an excess of 1,442. The excess of actual deaths in the week ending January 2nd, over the calculated average was 1,484, so that we may, in considering the details of the excess for the fortnight, limit our attention to the second week alone. To do so will save much trouble, and will not materially influence our conclusions. The death-rate for the *fortnight* averaged 32, and for the two weeks respectively, it was 21·9 and 42. Limiting our attention to the second of the two weeks, we find the following causes of death show a marked excess over the average:—

			Excess.	
	Average.	Actual.	Gross.	Per cent.
Measles	72	154	82	114
Whooping-cough	66	180	114	173
Phthisis	182	258	76	42
Old age	66	90	24	36
Apoplexy	50	79	29	58
Dis. of the Circulatory System	154	317	163	106
Bronchitis	344	927	583	170
Pneumonia	120	253	133	111
Other Respiratory diseases	51	120	69	135
Accidents	58	118	60	103
	1,163	2,496	1,333	115

It is noticeable that the excess of deaths is mainly attributable to lung diseases or zymotic diseases, such as whooping-cough and measles, in which lung complications are very common. Deaths from circulatory disease were also far above the average, but as anything which hampers the action of the lungs must exercise a baneful influence on the circulation, this is what one would naturally expect, and merely tends to strengthen the assertion that cold and fog kill primarily by their effect on the lungs.

The death-rate for the whole of London was 42, while the death-rates for the several districts were as follows :—

Northern	36·4
Western	43·68
Central	52·0
Eastern	47·32
Southern	39·52

It is noticeable that the western district suffered more than the northern or the southern, which is not to be wondered at, for with the slight airs from the East which prevailed the western districts would get the full effect of the foulness which drifted from the whole of the metropolis lying to the eastward. The highest fog death-rate was in the central district.

The high mortality caused by this fog was followed by a severe epidemic of influenza which lasted for six weeks, and the question naturally arises as to whether much of the mortality, apparently due to the fog, was not in reality caused by influenza. This does not seem probable, because in the week ending January 2nd, there were not more than 37 deaths from influenza recorded in London. On the other hand may it not be considered as probable that the stillness and torpidity of the atmosphere during the fog was favourable for the conveyance of the influenza poison and helped, as it were, in determining the severity and wide extent of the epidemic. This epidemic lasted for six weeks, and in these six weeks there were 17,576 deaths, or very nearly 6,000 more than the corrected average number.

As affording some evidence that infective particles are especially liable to be transported through the air during fogs, one may refer to Mr. Power's well-known report on the spread of small-pox from the Fulham Hospital in 1881. A large number of cases of small-pox occurred in the neighbourhood of this hospital during dull, foggy, calm weather, and Mr. Power remarks: "Familiar illustration of that conveyance of particu-"late matter, which I am here including in the term 'dissemi-"nation,' is seen summer and winter in the movements of

"particles forming mist and fog. The chief of these are, of "course, water particles; but these carry gently about with "them, in an unaltered form, other matters which have been "suspended in the atmosphere, and these other matters, during "the almost absolute stillness attending the formation of dew "and hoar-frost, sink earthwards, and may often be recognised "after their deposit. As to the capacity of fogs to this end, no "Londoner needs instruction. And there are reasons which "require us to believe particulate matter to be more easy of "suspension in an unchanged form during any remarkable "calmness of atmosphere. Even quite conspicuous objects, "such as cobwebs, may be held up in the air under such "conditions."

The presumption that the fog, apart from the cold, is a cause of the remarkable rise in the death-roll, is one which in the minds of most of us would require no proof, and we should regard it as a notorious fact. The Registrar-General's figures rather go to show that the death-rate is greatest in the central part of London where the fog is densest, notwithstanding that the temperature of the central districts of London is always higher than it is at the outskirts.

That the fog is, apart from the cold, a very virulent element of weather is also shown by the result of the notorious fog of 1873, which occurred during the Islington Cattle Show, and which so affected the beasts that 36 per cent. of them had to be hurriedly removed from the exhibition building, and many of them were as hurriedly killed in order to secure the butcher's purchase-money. It is hardly conceivable that cold, apart from fog, could have caused this potential mortality in animals, most of whom are accustomed to exposure at all times and seasons.

It is well known that a downward movement of the thermometer, apart from fog, is always followed by a rise in the death-rate from pulmonary disease, and that while the young are enjoying the exhilaration of skating in the crisp, clear, frosty air, the elderly and the delicate are succumbing before the extra work which is thrown upon the lungs and other organs in maintaining the body at its normal temperature.

It may be parenthetically remarked that it is most necessary to distinguish between that which causes a particular class of diseases, and conditions which are merely unfavourable for those who are already suffering from such diseases.

That cold *per se* is a great cause of lung disease, we have very little evidence to prove. As regards phthisis, it is well known that there is less in Northern Europe and Canada than there is in places further South, and we also recognise that many

incipient cases of phthisis do excellently well in very elevated regions where the cold is intense. It is now recognised that phthisis is a true infective disease, and that no merely physical conditions without the living *causa causans* are competent to produce it. *Acute pneumonia*, too, is now known to be a true infective disease, which not unfrequently is very contagious. phthisis and acute pneumonia both belong to the air-borne contagia, and the hygienic condition most favourable for their occurrence undoubtedly is over-crowding. That intense congestion of the lungs which occurs when the feeble are slowly dying, is a disease, if disease it can be called, probably quite distinct from acute pneumonia, and it is admittedly very common in very aged people, who succumb during cold weather. Bronchitis has always seemed to me to be mainly predisposed to by dietetic errors rather than climatic conditions, and if I were asked to name the chief predisposing causes I should say alcohol, over-crowding, and dust, placing alcohol decidedly first. Although I am not disposed to recognise cold *per se* as in any sense a great cause of lung disease, yet I nevertheless recognise that it is a *most potent* cause of death in those who are already suffering from lung disease. The sufferers from chronic lung disease are always with us in this over-grown town in enormous numbers, and with the advent of severe weather these succumb to the adverse circumstances, their enfeebled organs being unable to bear the extra strain of maintaining the animal heat.

Sufferers from lung-disease or heart-disease feel the effects of cold very quickly, and the bronchitic have always increased difficulty of breathing and increased secretion from the lungs, due possibly to congestion of the lungs induced by the cold.

If the sufferer from chronic lung disease does not like the cold, he abominates the fog; and all such are unanimous in declaring that the irritating effect of the fog is quite distinct from the effect of mere cold.

As a physician, I have no hesitation in saying that the physical condition of the air known as fog is very trying to sufferers from bronchitis and other lung troubles. Physiologists tell us that air containing about 70 °/₀ of moisture is most agreeable for breathing purposes, and that quantities materially above or below this figure make the air unpleasant for respiration. The human body has to get rid of a certain amount of moisture by the lungs, and it is evident that when the medium in which the body is placed is not only bitterly cold, but saturated with moisture as well, there must be difficulty in getting rid of this moisture. Again, one would ask whether a cold and saturated air does not chill the lungs more than

tolerably dry air of the same temperature, and whether the saturation of the air with moisture does not in some degree interfere with that interchange of oxygen and carbonic acid, which is the essence of the respiratory act?

Whatever the explanation may be, there can be no doubt that the fog is in itself a very trying condition, especially for those who are the subjects of lung-disease.

But, it will be urged, we do not hear of fatal results from being in the fog on the banks of Newfoundland, nor do we hear of such occurrences in country districts. The fatality of fog seems limited to London and the big towns.

During a fog it is undoubted that the carrying powers of the air for solid particles is increased, and the dust of various kinds projected into the air has a lesser tendency to obey the force of gravity, than when the air is free from particles of moisture. It thus follows that the air of big towns becomes very impure during a fog, and *it is the mere concentration of the constituents of the ordinary London atmosphere which gives the virulence to the London fog.*

The importance of this conclusion is very great, for it amounts to saying that when the stagnation of the air in London reaches a certain degree, it is inevitably fatal to a large number of its more fragile inhabitants.

Let us stop to consider the composition of the London atmosphere. The fog proper depends upon causes beyond our control, but the dirtiness of the air of London may fairly be looked upon as something which is manufactured by its inhabitants, and therefore to a certain extent within our control.

In 1841, a little more than half a century ago, London contained less than 2,000,000 inhabitants, and the maps of the period show that the limits of the town were (roughly) Lord's Cricket Ground in the north, Kennington Oval in the south, Knightsbridge in the west, and the London Docks in the east. Now London extends from Tottenham to Croydon and from Richmond to Woolwich, and contains, within these limits, some 5,000,000 inhabitants. The town has undergone an enormous increase in its area without any diminution in the density of its population. If we allow one chimney to every five inhabitants we must allow an increase of 600,000 domestic chimneys since 1841. If we bear in mind the enormous increase in the use of steam and gas for motive purposes we must admit that probably the fouling of the air by combustion, necessitated by manufacturing industry, has increased in a ratio greater than the increase in the number employed in such industries. We must not forget that the animal population increases with the human, and when we estimate the density of population for sanitary

purposes we ought to reckon in the domestic animals and especially the horses.

Not only is the air fouled by respiration and combustion, but also by putrefaction, and when considering the fouling of the air of London, one must remember the dung-heaps of the stables, the droppings of the streets, and the effluvia which escape from the ventilators of the 2,000 miles of sewers which lie beneath our streets. When one considers the magnitude of the fouling of the air from various causes, and when we bear in mind that a fair percentage of the inhabitants are suffering from phthisis, pneumonia, influenza, scarlet fever, whooping-cough, measles and diphtheria. and when we remember that a large number who are not suffering from definite disease, have unwholesome breath as a result of pathological conditions of the teeth, mouth and air passages, we cannot be surprised that a stagnation of the air should produce effects more or less disastrous. London can have very little power, during a dense fog, of purifying its air. Vegetation of all kinds is scanty in the central parts of London, and evergreens merely degenerate into everblacks and die. Even if green leaves did exist, their chlorophyll could not act in a place where, for a month at a time, there is no sunshine, and thus London in a stagnant fog is left to stew in its own gravy until a welcome wind blows away the filthy pall which covers it.

In the fifth volume of the Transactions of the Seventh International Congress of Hygiene and Demography will be found two most excellent papers dealing with the subject of Fog and Smoke. One is by Dr. W. J. Russell, F.R.S., on "Town Fogs and their effects," and the other, on the "Prevention of Smoke from Factories and Dwelling Houses," is by Mr. A. E. Fletcher, H.M.'s Chief Inspector under the Alkali, &c., Works Regulation Act.

Mr. Fletcher contends that the Acts introduced by Lord Palmerston in 1853 and 1856, making it penal to allow black smoke to issue from any factory chimney within the metropolis or from any steam vessel plying on the Thames, have had the effect of relieving London from nearly all the smoke of factory chimneys. "But," he adds, "the smoke of dwelling houses remained." If we accept as a fact that the smokiness of London is due to the domestic fireplace, it is nevertheless impossible not to believe that the amount of smoke emitted *per head of population* must be considerably less than formerly. The increased use of gas for cooking purposes, the improvements which have been effected in grates, and the employment of steam or hot water coils must have had, one would think, the effect of diminishing the amount of smoke per head, unless

(which is not improbable) the increase in the rate of wages and increasing luxury in the matter of hot bath, &c., has caused a demand for more heat per head of population, and thus the increased consumption of fuel has more than balanced its improved combustion.

According to Dr. Russell the amount of coal used in London (excluding that used for gas-making) was in 1879 5,838,891 tons, while in 1889 the amount had risen to 6,390,850 tons, an increase which is about proportionate to the increase in population.

Nobody who is an early riser can doubt that the domestic fire-place is the main cause of the smokiness of London. At six o'clock in the morning the air is not unfrequently clear and brilliant, but these qualities disappear an hour later when the preparations for the morning meal have necessitated the lighting of the fires. The amount of smoke is probably greatest between 7 and 8 a.m., because the best of grates will emit more or less smoke when just lighted. Later in the day the domestic smoke diminishes, and one must admit that it is not common to see the domestic chimney emitting very much black smoke.

Notwithstanding that factory smoke has been practically abolished in London and that many causes have conspired to diminish the amount of domestic smoke per head, the dirtiness of the air and the number of fogs have increased. Thus Dr. Russell states, on the authority of Mr. Brodie, that in—

1870-75	93	winter fogs occurred.
1875-80	119	,, ,,
1880-85	131	,, ,,
1885-90	156	,, ,,

And I think we should all agree that the central part of London gets gradually dirtier, and that the necessity of employing artificial light in the day-time is increasingly felt.

How can it be otherwise in a place which is steadily increasing both in area and density? The circle of houses round the centre of London requires a radius of eight or ten miles for its inclusion, and in the central districts of London, no matter what may be the direction of the wind, the air is mixed with the dirty effluvia of men, animals, and chimneys, and can never be "fresh."

A more important point as leading to increased dirtiness of the air is the increased density of houses and population, especially in the centre.

It is hardly necessary to point out that a house of nine storeys has, probably, three times as many fire-places as a house of three storeys, having a similar area. In the country the

smoke of our houses is blown away and diluted and causes us no practical inconvenience; but in London we have not only been building upon every vacant space, but we have been increasing the height of our dwelling houses and building towers full of offices and huge piles of flats, and we clearly have no cause to grumble if the air gets dirtier, and the death-rate does not go down. We have legislated against back-to-back dwellings, and yet allow them to be piled nine and ten in a heap, which seems to suggest that there is one law for the rich and another for the poor. That the increased frequency of fog is due to the increase alike of area and density of the city there can be no doubt. There are more men and chimneys on a given space, and therefore the effluvia are less frequently diluted to vanishing point.

The physical and chemical aspects of fog are of great interest. Aitken has shown that fogs do not form in a pure atmosphere which is absolutely free from floating dust particles; but as there is enough dust in the air off the coast of Newfoundland to allow of the formation of fogs of impenetrable density, it is obvious that the practical bearings of this interesting discovery as affecting the air of cities are not very important, for it would be manifestly impossible to get the air of London or any big town to such a degree of cleanliness that fog would not form. The chemical impurities which are found in the air during a fog are both gaseous and solid. Carbonic acid and sulphur dioxide are the more important gaseous impurities.

Dr. Russell has found the carbonic acid during a fog to be raised from four parts to fourteen parts in 10,000 of air; and a committee of the Manchester Field Naturalists' Society have shown that the amount of sulphur dioxide present in the air of that city may vary from 0·28 milligrams per cubic metre (an amount observed at Owen's College, Manchester, on March 6th, 1891, after two days' strong wind), to 7·40 milligrams per cubic metre (an amount observed at the Town Hall, Manchester, on February 27th, 1891, during a fog). The amount of impurity increases as one passes from the outskirts to the centre of a town.

The Manchester Field Club have further estimated that during a three days' fog $1\frac{1}{2}$ cwts. of sulphuric acid per square mile were deposited in the centre of Manchester, while at an outlying station 1 cwt. of sulphuric acid and 13 cwt. of "blacks" per square mile were carried down in the same time.

Those who have a garden anywhere on the western side of London cannot fail to remember a fog in February, 1891, which covered the evergreen shrubs with a slimy deposit and gave an irridescent appearance to all the puddles in the road. Happily

the fog was subjected to scientific investigation. The matter deposited on Messrs. Veitch's Nursery at Chelsea, and on a plant house at Kew, was analysed. At Chelsea 20 square yards of roof gave 40 grammes of deposit, while at Kew the deposit on the same area amounted to 30 grammes. It is interesting to note that not only was the deposit more copious at Chelsea than at Kew, but it also contained a larger percentage of hydrocarbons and acids.

The following is the analysis of the deposit at Chelsea:—

Carbon	39·00
Hydrocarbons	12·30
Organic Bases	2·00
Sulphuric Acid	4·30
Hydrochloric Acid	1·40
Ammonia	1·40
Mineral matter (chiefly Silica and Iron Salts)	33·80
Water (estimated)	5·80
	100·0

That these deposits proved ruinous to plants goes without saying, for the leaves were choked by it. The large amount of acid and hydrocarbons in the air also explain the intensely irritating nature of a typical London "Pea Soup" fog, and certainly a contemplation of this analysis makes it impossible to believe that the mortality accompanying a London fog is due entirely to the cold, as some have maintained. The corrosive power of London air is seen in its destructive action on metals. We all know how the metal fittings in our houses tarnish and corrode, and we all know that bronze statues exposed to the London air quickly contract a worm-eaten appearance.

The air of London is never "fresh," a quality which is to be gauged entirely by the nose. Although we may be in doubt as to the physical or chemical basis of "freshness," we are most of us inclined to attach great importance to it as one of the most valuable qualities which air can have. It is the necessity for fresh air which has compelled us to supplement the London Hospitals with a large number of Convalescent Homes at the Seaside and elsewhere, because experience has shown that the power of recovery after acute illness in London or in any large town is very much less than it is in the country. This quality of freshness consists in an absence of foulness, a condition of things which cannot exist for many miles to leeward of a big city like London. It is also almost certain that the air cannot be fresh unless there be green things to freshen it. The

chlorophyll of the green leaves of plants under the influence of sunlight is constantly engaged in absorbing carbonic acid *from* and returning oxygen *to* the air, and on this account it is tolerably certain that vigorous herbage is necessary for the freshening of the atmosphere which we breathe.

In the centre of London comparatively few plants will live, and fewer still will flourish; and even those which do flourish have to contend with an absence of sunlight, which is very prejudicial to the vigorous action of the chlorophyll. It thus follows that the regenerative power of the air in the centre of London is very small; we become entirely dependent upon the wind for our fresh air, and the stagnation of the air is consequently a more serious matter in London than it is elsewhere.

Thus one is led naturally to the discussion of another fact which is all too evident in London, viz., the absence of sunlight.

There can be no doubt as to the importance of sunlight. We know that the activity of the chlorophyll of plants is directly proportioned to the amount of sunlight, and we know that plants deprived of sunlight become etiolated and pale. When we see the radiometers rotating in the opticians' windows we have a demonstration that sunlight is a cause of motion, and all the wonders of photography are calculated to impress upon us the influence of sunlight upon chemical action. We know also of certain things which love darkness rather than light, and among them are the vegetable bodies which contain no chlorophyll, such as the fungi, inclusive of many of those which are recognized as direct causes of disease. It has been proved, with regard to some of these disease-causing microbes, that exposure to the sun's rays materially inhibits their growth.

These facts make it certain that the presence of sunlight is most important for the well-being of mankind, and the Italians have a proverb which says that the Doctor is sure to visit those places where the sun never comes.

Nevertheless we know very little that is accurate concerning the effect of sunlight upon the animal economy. It is probable that the pallor of town-dwellers is in part owing to the absence of sunlight, and it is certain that pallor must mean a deficiency either in the quantity or quality of the hœmoglobin, the red matter of the blood which is apparently analogous to the chlorophyll of plants. Such a deficiency must interfere with metabolism and development, and it seems impossible not to believe that the want of sunlight is a factor in the causation of rickets the commonest of all the diseases of London, albeit that it makes very little show in the returns of the Registrar-General.

The rickety child is anæmic and flabby, and little able to

withstand those minor ailments which seem to be the lot of all. Of the thousands of children who annually die in London of measles, whooping-cough, bronchitis, pneumonia, diarrhœa; how many were rickety to begin with? On this point our statistics are silent, but the common experience of a hospital physician would lead him to say "the majority." The infantile mortality figures (deaths under one year of age to one thousand births) are always much higher in towns than in country districts. A quickly developing child naturally feels the want of fresh air and sunlight more than an adult, and hence it follows that the air of a big city which is not good for any of us, is especially bad for children.

Having arrived at the conclusion that the increase in the amount of fog in London is due to the increase in the area and density of the city, and having also shown that the atmosphere of London in time of fog is merely an exaggeration and concentration of its normal atmosphere, it may be instructive to turn our attention to that portion of London which experiences the greatest difficulty in obtaining fresh air—the central districts of the Registrar-General.

The central districts of the Registrar-General include the districts of Holborn, the Strand, St. Martin's, St. Giles', and the City.

These districts in 1861 contained a population of 383,321; in 1871 a population of 334,369; in 1881 a population of 282,238; and in 1891 a population of 247,140.

These central districts constitute the very core of London, and, roughly speaking, extend from St. James' Park to the Tower, and from the Pentonville Road to the Thames.

They occupy 2,132 acres, and appear to have reached their maximum density of population in 1861, when they contained slightly more than 171 persons to the acre, since which time the night population has decreased, and according to the last census they contained about 115 persons to the acre.

In the "Annual Summary of Births, Deaths, and Causes of Death in London and other Great Towns, 1891," published by the authority of the Registrar-General, will be found a table (Table 9) giving the London mortality in five groups of districts, from 1841 to 1891.

Let us first take from this table the mean rate of mortality in the five decennia intervening between the beginning of 1841 and the end of 1890.

In the Western districts the mean rates of mortality have been 23·0, 22·6, 22·7, 20·8, 19·7.

In the Northern districts the mean rates of mortality have been 22·7, 22·2, 23·6, 21·9, 19·1.

In the Eastern districts the mean rates of mortality have been 26·2, 25·1, 26·9, 25·0, 23·7.

In the Southern districts the mean rates have been 26·2, 24·4, 23·4, 21·9, 19·5.

Thus it will be seen that in all these districts the rates of mortality have tended steadily to diminish between 1841 and 1891, this diminution being most marked in the southern districts and least marked in the eastern districts.

When, however, we come to the Central districts we find no such steady diminution, the mean rates of mortality for the five successive decennia having been 24·7, 24·4, 26·5, 24·9, 23·3.

This seems a fact of such prime importance that it is advisable to consider it more in detail, and accordingly I add from this table the death-rates in the central districts for every year, from 1841 to 1891.

Annual Rate of Mortality in Central Districts.

1841	25·0	1867	24·8
1842	23·6	1868	25·2
1843	25.3	1869	26·6
1844	24.4	1870	26·0
1845	24·0	1871	25·0
1846	22·9	1872	23·6
1847	27·9	1873	25·1
1848	25·3	1874	25·7
1849	27·9	1875	26·2
1850	21·1	1876	24·1
1851	24·1	1877	24·2
1852	23·9	1878	25·2
1853	25·1	1879	26·3
1854	27·4	1880	23·8
1855	25·1	1881	23·4
1856	23·0	1882	24·0
1857	23·8	1883	23·3
1858	24·5	1884	23·8
1859	24·1	1885	22·9
1860	23·3	1886	23·4
1861	25·4	1887	23·5
1862	26·2	1888	22·7
1863	26·9	1889	20·9
1864	29.5	1890	24·8
1865	27·1	1891	26·5
1866	27·1		

We thus arrive at the rather startling fact that not only has there been no material decrease of the mortality in these central districts in the half-century intervening between 1841 and 1891, but that the mortality for the last recorded year, 1891,

was actually the highest on record since 1869, and has only been exceeded on eight occasions.

Compared with the high rate in the central districts of 26·5 for the year 1891, we find that the rate for the same year in the other districts of London was as follows:—Western, 20·8; Northern, 20·0; Eastern, 24; and Southern, 19·8. The rate of mortality for the whole of London in 1891 was 21·4.

We naturally look for some explanation of this high mortality in the centre of London. Is it due to the hospitals contained in the central districts of London, and do the inhabitants of outlying districts flock to hospitals and institutions in the central districts to die in them, and thus unduly swell the mortality?

The answer to this is "No," for a table (Table 11) given on p. xii. of the report from which I am quoting, gives a corrected return of birth and death-rates for the districts of London in 1891, in which the deaths of non-residents occurring in hospitals have not been included.

From this it appears that the corrected death-rates for the districts of London were as follows, and for the sake of comparison I have placed the uncorrected death-rates alongside them:—

District.	Corrected death-rate.	Uncorrected death-rate.
Western	19·5	20·8
Northern	20·0	20·0
Central	27·6	26·5
Eastern	23·9	24·0
Southern	20·2	19·8

It thus appears that more persons left the central districts to die elsewhere than came from the other districts to die in them, and that the true death-rate of the central districts for 1891 was 27·6.

Turning to another table on p. xvii. of the report, in which the corrected death-rate for 28 great towns is given for 1891, we find that the figure for central London (27·6) is higher than that for any of these big towns.

The deaths of children under one year of age to every 1,000 births were, for the whole of London, 154, for the central districts 177.

Before the death-rate of the central districts can be acknowledged as true a further correction must be made for age distribution. This correction would certainly tend further to augment the figure, but to what extent it is difficult to say without an exact knowledge of the number of persons living at each age in the districts. In London, as is well known, there

is a deficiency of persons at the extreme and most vulnerable periods of life, the population of the central districts especially being maintained by the constant immigration of selected adults from the country, among whom the death-rate should be low. Again, we must bear in mind that the corrections made in the death-rate by the Registrar-General are corrections which are entirely in the interests of London. Care is taken that the London death-rate should not be swollen by the inclusion of visitors from outside who die within its limits; but no correction is made in the interests of the country, as a whole, for persons who, falling ill in London, go out of it to die. I cannot but believe that in this matter our exports would considerably more than balance our imports; for it is notorious that directly a man falls ill in London, we send him to the country to regain his strength or die, as the case may be.

There can, I think, be no doubt that this high death-rate of 27·6 is, nevertheless, considerably too low if we are to honestly compare it with the mortality figures of the country as a whole.

But it may be urged that these central districts are poverty stricken, and there can be no doubt that there is a considerable amount of poverty concealed by the palatial buildings which abound in them. These central districts are certainly not so poor as the eastern districts, and although there is no little poverty in Holborn, Clerkenwell, and St. Luke's, it is largely counterbalanced by the wealth of the Strand, the City, and Bloomsbury. These districts may be poor, but most certainly the poor which live in them are better off than they were fifty years ago, and the gradual and complete disappearance of typhus fever may be taken as evidence that there cannot be any large amount of serious want. The disappearance of typhus is due to cheap food; and cheap food in cities has been brought about by Free Trade.

In looking at these death-rates for the central districts from 1841 to 1890 one cannot but be struck with their comparative uniformity, and the absence of figures which seem to point to any particular years as especially pestilential. In 1846, 1847, 1848, and 1849—years memorable for want, social disturbance, and cholera—the death-rate averaged 26 only. In 1854—a year of cholera—it was 27·4, and in 1866—another cholera year—it was 27·1.

The highest death-rate was in 1864 when it stood at 29·5, the lowest recorded was in 1850 when it stood at 21·1.

The fact that the Cholera years make so small a show in the death-rates is interesting, because, as is well known these districts have enjoyed the excellent water-supply of the New River, and did not in 1854 and 1866 get any material part of

their water from the Thames between the bridges or from the polluted Lee.

There is in fact no reason why these central districts should suffer from the effects of water-borne contagia, more than any other districts, and it appears evident that the high mortality which persists in them is not due to any defect of water supply.

It is rather mortifying to contemplate the persistent high death-rates in these districts, when we consider the money which has been laid out in them for the express purpose of improving their sanitary condition.

The opening of the New River, the rebuilding after the great fire in 1666, the removal of the city walls and gates, the covering of the Fleet Ditch, the making of the main-sewers, the construction of the Thames Embankment, the closing of the City churchyards, the laying out of the New Road, Cannon Street, Queen Victoria Street, the Holborn Viaduct, Northumberland Avenue, Farringdon Street, Shaftesbury Avenue, New Oxford Street, the Metropolitan Railway, the improved lighting, the magnificent paving, enforced vaccination, enforced education—these are among the public measures of "betterment," every one of which should have the effect of improving the Public Health.

Again, we have new markets, new bridges, model dwellings, an Adulteration Act, a Notification Act, an army of inspectors for slaughterhouses, dairies, and factories, and a complete set of hospitals and asylums in neighbouring counties to which are sent paupers, lunatics, imbeciles, and cases of infectious fevers.

These central districts form a city, which is equal in magnificence to any city in the world, and which, when viewed upon a fine day, is calculated to inflame the imagination and rouse every feeling of patriotic pride. Nowhere on the globe can one see a greater concentration of municipal magnificence or a greater variety of fine buildings, whether public or private. Nowhere, probably, is to be found such ample and luxurious hotel accommodation for visitors, and nowhere is there a Vanity Fair more profusely furnished with theatres and halls of pleasure, with shows and shops. Were it not for the fact that the Registrar-General drags a mummy across the scene marked with the figure 27·6 our enjoyment would be unalloyed.

The hygienic difficulty with which these central districts have to contend is not that of water-supply, sewerage, or food supply, but a difficulty in getting an adequate supply of fresh air.

On paper they appear to have undergone a diminution of population, but from the hygienic point of view such a statement is obviously misleading. It is true that fewer people *sleep* in these districts than was the case thirty years ago; but

for at least eighteen hours out of every twenty-four the overcrowding is excessive. Is there any time of the day or night when these districts have not in them some thousands in excess of the sleepers? After the eighteen theatres have closed their doors, the printing-offices of the daily papers are crammed to repletion, and then come the market people; and these are followed by the daily toilers on the busy scene. Judging from the day census of the city proper, it is quite safe to say that at least a million people visit these central districts daily, of which probably half-a-million have occupation there; and these help not only to use up the air, but not improbably leave it "seeded" with a fair percentage of infective particles. If we look rationally at these central districts we must admit that for practical purposes the over-crowding is infinitely greater than it ever has been.

It is somewhat humiliating to find that after all our efforts the death-rate of Central London has undergone no material change during the last 52 years.

It is also rather humiliating to have to admit that the lowering of the death-rate in districts other than the central, is probably due to dilution rather than genuine improvement. In 1841 London contained some 1,800,000 inhabitants; to-day it contains 4,250,000, an increase of 2,550,000. At the same time the central districts have decreased to the extent of 136,000 and from this we are entitled to conclude that of the 4,250,000 inhabitants of London, at least 2,686,000 are living in absolutely new districts which having been developed since 1841, and stretching from the centre into the country, have served to dilute the central death-rates. It is not very far from the truth to say that 60 per cent. at least of the inhabitants of London live in a city which was non-existent 50 years ago, and considering the amount of building which has been carried out since 1841, it is certain that considerably more than 60 per cent. live in houses which are absolutely new.

Although no improvement has taken place in the death-rate of the central districts of London I do not wish to be understood as speaking lightly of the sanitary work which has been carried on in those districts. Far from it, for it is certain that without the strenuous efforts which have been made to try and grapple with the sanitary problems in such a hemmed-in and crowded area, the death-rate must have risen to a far higher figure than any of those which I have quoted.

Again, we must be careful to distinguish between crowding *out of doors* and crowding *indoors*, and we must remember that crowding in houses and under a common roof is infinitely the most dangerous form of crowding.

Now a city like Central London which has been built upon no fixed plan, and with no universally applicable rule for keeping a due relation between the cubic contents of a building and the area it occupies must constantly be in need of surgical interference to relieve congested areas. William Cobbett, in his "Rural Rides," invariably speaks of London as "The Wen," *i.e.*, he regarded it as a pathological growth, and there can be no doubt he is correct in his point of view, as is shown by the frequent recurring necessity for surgical interference. We have cut broad streets and avenues through the slums in various directions, and a new scheme of civic surgery, which is to cost three and a half millions, is just now occupying the minds of our County Councillors.

Now this process of Haussmannizing a City may add greatly to its architectural beauty and doubtless serves to facilitate traffic and business, but it is tolerably certain that such schemes by increasing the over-crowding *indoors*, are more likely to increase than to decrease the death-rate. When we sweep a path through the snow the snow is piled on either side, and when we cut a thoroughfare through the slums the inhabitants (unless they be driven out of the district entirely), are piled up in so called model dwellings, at the sides of the new boulevard, and those who probably had a house to themselves with a little backyard for airing the children, find themselves provided with "quarters" in a barrack, and under the same roof with dozens of others, a most admirable arrangement for the mutual exchange of scarlet fever, whooping-cough, measles, diphtheria, influenza, and other infective commodities.

The concentration of houses, and the concentration of inhabitants under a common roof, must increase the amount of air-borne disease, and there can be no doubt that with the increasing height of our houses and the ever increasing area of the city, the mortality of the centre of London is certain to increase.

In the first quarter of last year (1892) we had a very sharp epidemic of influenza in London which lasted for six weeks and caused, approximately, 1,000 extra deaths per week while it lasted. The effect of this epidemic, which was due to air-borne contagia, is shown in the corrected returns of the Registrar-General for the first quarter of 1892.

The death-rate for the whole of London during this quarter was 27·8, and the total deaths amounted to 29,529.

A glance at the returns shows that, roughly speaking, the death-rate of the various districts rises as we proceed from the circumference to the centre of London, and certainly the central districts of the Registrar-General show a rate of mortality which

is deserving of attention. Taking these central districts in order of mortality we find that the death-rates for the first quarter of 1892 were as under:—

Strand	44·0
Holborn	36·6
St. Luke's	35·5
Clerkenwell	35·3
St. Giles's	35·1
City	33·0
St. Martin's	27·7

The infant mortality figure, which for the whole of London stood at 179, was no less than 317 in the Strand, 244 in the City, 229 in Holborn, 217 in St. Martin's, 212 in Clerkenwell, 186 in St. Giles's, and 170 in St. Luke's.

In St. Luke's the birth-rate for this quarter was exceptionally high (45·2), and the births exceed the deaths by 99. In each of the other central districts, however, the deaths considerably exceeded the births, a fact which was due as much to the exceptionally low birth-rates as to the exceptionally high death-rates. If we exclude St. Luke's we find that in the six remaining districts the deaths exceeded the births by 452.

The smallness of the birth-rates (St. Martin's, 16·9; City, 17·5; Strand, 24; Holborn, 27; St. Giles's, 30·4; Clerkenwell, 33·5) shows how abnormal must be the age distribution, and that when the human birds pair they have largely given up the central districts for nesting purposes.

The over-crowding which is so marked a feature, not only in London but in all modern cities both here and in America, may be usefully looked at from another point of view. This over-crowding has arisen from a too absolute neglect of what may be called the "earth unit." Not only does every living being require for his support a certain definite average amount of pure air and pure water but also a definite average amount of the earth's surface, to provide him with food and clothing. What this average definite amount of the earth's surface is, it is difficult, perhaps impossible, to say, but I have given some figures in a paper which I lately contributed to the *Medical Magazine* which lend support to the supposition, that in the British Isles about one acre of cultivable land might reasonably be taken as an earth unit sufficient for the bare support of each individual of the population (including both sexes and all ages). If the individual really inhabited his unit there need be no difficulty about fresh air, water-supply, or burial. Steam and Free Trade have enabled us to neglect this unit absolutely, for dwellers in cities may and do draw their supplies from the Antipodes, and there is no longer any absolute necessity for

market gardens or farms in the immediate neighbourhood of cities. Free Trade has facilitated the crowding into cities, and our modern methods of sanitation have enabled us to build houses of any height and as close together as it is possible to pack them. We have neglected the earth unit absolutely, and we are encountering serious difficulties in consequence, and one of these is the thick impure atmosphere of cities, and dense black fogs when the climatic conditions are favourable for their formation.

Thus far we seem to have arrived at the conclusion that the increase in fog and darkness in London is a natural consequence of the increase both in area and density of the City, whereby too many fire-places are packed on a given area. In considering remedies for this state of things we must have regard both to the sanitary and commercial aspects of the question. If the air of London could be purged of its dirt there can be no doubt that the beauty of the city would be immensely increased, and that the saving of money would be very great. It is difficult to estimate the money loss to London tradesmen, caused by a fog like that of Christmas, 1891. In damage to goods, loss of custom, and increased difficulty and expense in the transit of goods the loss must be prodigious, and on this ground, if on no other, we should make every effort to lessen the dirt of the London air.

Let us suppose that all our houses were warmed by steam coils; all our cooking done by gas, and all our artificial light generated by electricity. The London atmosphere would then be comparatively clean, but for the dust raised by 5,000,000 people in incessant motion.

Would London be any healthier in consequence of such a reformation? The answer to this is doubtful. We have seen that there is good reason for supposing that the evil effects of a London fog are due in a great measure to the stagnation of the London atmosphere; and it seems needless to insist that such stagnation is far more intense indoors than in the street. Now, our open fire-places undoubtedly serve in a marvellous way to renew the air in our dwellings; to sterilise all air which passes through the fire into the chimney, and also, doubtless, to cause currents and movement in the air round the tops of the chimneys where the hot gases escape. With the utopian reformation I have imagined the open fire-place would disappear, and I am on the whole disposed to believe that the death-rate in the central parts of London would increase as a consequence. I do not for an instant believe that our smoky atmosphere has any antiseptic action, as has sometimes been suggested, but I do believe that the increased movement of the air caused by open

fires, must lessen the risks of infection, especially among such as are crowded under a common roof.

Let us suppose a reform rather less sweeping than the one I have imagined, and let us consider what would be our condition if by the use of smokeless fuel, such as gas, coke, anthracite, and by the employment of improved grates the smoke from our chimneys were practically abolished. Now we must remember that it is impossible to burn fuel without fouling the air, for even if we get rid of the "blacks," which are not the result of combustion but rather of wasteful non-combustion, we should still have the true products of combustion to deal with, viz., carbon-dioxide, probably some carbon-monoxide, watery vapour, sulphurous acid, sulphuric acid, and hydrochloric acid. None of these would be lessened, however perfect the combustion, and all of these (except the watery vapour) are either poisonous or irritating or both. I fail to see that (except for the lessened dirtiness) we should be much better off, and I believe that a prolonged winter fog would continue to have the same effect upon the death-rate as at present.

The abolition of "blacks" in London is indeed a "consummation devoutly to be wished," and for the attainment of this end, it would be worth while to make very considerable sacrifices; but I doubt very much whether the means proposed (smokeless fuel and perfect combustion in our grates) would produce a perfect cleanliness of the air. We all know, for instance, how dirty gas is and how black it makes our ceilings and our walls, and it is hardly rational to suppose that combustion in our grates can be more perfect than the ordinary combustion of gas. Then again I will remind you that in every 100 grammes of the solid deposit collected in February, 1891, on Veitch's plant houses at Chelsea, 39 grammes consisted of carbon and nearly 34 grammes consisted of metallic iron, magnetic oxide of iron, ferric oxide, and mineral matter, chiefly silica. This seems to show that the hot blast from our grates carries with it not only mineral dust from the fuel, but probably siliceous particles and debris of iron from the chimneys and chimney pots.

It seems, in fact, tolerably clear that of the amount of solid particles in the air of London, not more than half could be abolished by improved grates and smokeless fuel. This seems to me, in the present state of our knowledge, to be the highest ideal attainable.

Again it is not possible to suppose that all the dirt in the air of London is due to the chimneys. A good deal of it must be caused by the incessant traffic and movement of some five million persons on a limited area.

In short, the density of our fogs is largely due to the density

of population, and it is doubtful whether any Parliament would attempt to limit the population density of our cities, because to do so would seriously interfere (so it is thought) with money making.

Of late years, what may be called a new phenomenon in connection with the air of London has frequently been observed, viz., the high fog or high darkness, which, while leaving the streets quite free from mist, effectually shuts off the light of the sun, and gives us a darkness in every way comparable to the darkness of night. This must be due to a bank of fog hovering over the city, and the explanation of this new phenomenon is probably to be found in the enormous increase in area which the city has undergone of late years. The smoke of some densely populated outlying part is caught as it were in a passing cloud of vapour, which, drifting far over the tops of the houses, acts as an absolutely opaque screen between us and the sun.

Although I am of opinion that the dirt in the London air can only be cured to a limited extent, it is nevertheless our duty to do our utmost in the matter.

When the Coal Dues were removed by the London County Council it would have been well, perhaps, if the remission of tax had not been extended to bituminous fuel. Certainly the removal of the Coal Dues was not in itself a measure likely to diminish smoke. Whether it would be possible to penalize the domestic chimney for misbehaving itself in the matter of smoke is very doubtful, and whether such penalty should fall upon occupier, owner, or ground landlord is again doubtful.

The dirtiness of London air being mainly due to the density and area of the City in the matter of people, houses, and chimneys, can nothing be done to lessen the density? I am afraid the answer to this must be that such measures do not come within the range of Practical Politics. London is regarded as a place for making money in, and people who come to it for that purpose are very unwilling to be pestered with vital statistics. People rush into London from the country, go to their offices, and rush out again, and as a consequence they have no local feeling for a place which is associated with the toils of life rather than its amenities. Even in the residential quarters the inhabitants must be regarded as birds of passage, for a lease terminable in 7, 14, or 21 years represents the only tie which fixes them in one locality, and the depreciation of value in the house which they inhabit, owing to the too near approach or increased height of other houses, is not a matter which very greatly concerns *them*, and as for the ground landlord the closer the houses the greater the profits.

That London will go on for some time yet getting progressively worse there can be little doubt, but, nevertheless, it is useful to point out how its troubles have arisen, for although one may have no local feeling for what Cobbett called "the Wen," one would be sorry to see her bad example in sanitary matters recklessly imitated. The popularity of London has arisen from its natural advantages of situation on a fine navigable river. These advantages are increased now that it is the terminus of every important railway in the country. The communication by means of steam with the rest of the country and the rest of the world, has enabled it to draw its supplies from immense distances, and it has been able to build, without a thought for the consequences, on the ground which formerly was indispensable for growing vegetables and feeding cows.

Free Trade, by the removal of all restrictions on imported food, has increased the facility of feeding town populations. Free Trade has probably been the main cause of the disappearance of typhus, but, inasmuch as it facilitates the crowding into towns, it is a measure which has exercised a very doubtful influence on the public health.

Steam and Free Trade have undoubtedly stimulated the growth of London, and steam again must be held answerable for the most serious element in its growth—its increased density of population owing to increased height of the houses. This has come about by the possession of *water under pressure* and the *cast iron water pipe* whereby water supply and filth removals can be efficiently provided for in even the loftiest buildings. This it is which has caused the great increase in the height of the houses and has encouraged the tenement house with its inevitable overcrowding. This fact was pointed out by me last year in a free lecture delivered at University College, London, and it was also insisted upon that the modern City is distinctly a modern invention, that it had no counterpart in ancient times, and that as overcrowding is by far the greatest of all sanitary evils, the modern tendency to build houses without any curtilage, is a most dangerous one, and calculated to more than counteract the efforts which have been made to improve the health of our cities.

I am quite willing to admit that it is not a matter of very great consequence whether the death-rate of London be high or low, and I feel very confident that if its inhabitants were polled as to whether they would like a lowering of death-rate or an increase of trade profit they would choose the latter. Nevertheless, I hold the opinion strongly that if a city is to be kept healthy, its density must not be allowed to pass certain limits, and the building operations must be carried on in accordance

with some principle by which a proportion is maintained between the cubic contents of a house and the area of ground it occupies. That the interpenetration of the houses by open spaces, and the making of house curtilage obligatory, are both necessary measures if a city is to continue decently wholesome I have no doubt. I shall be told such a proposition is not practical on account of the high price of building land. I am sorry for it, but I have not been able to think of any other regulation which would serve to prevent the overcrowding of a city, and, as for the high price of building land, that is largely due to the absence of any adequate rule for defining the proportion between the cubic contents of a house to the curtilage which shall surround it. Any such rule to be of any use, must be an universal rule applicable to the whole country.

Many attempts have been made from the days of Elizabeth downwards to restrict the growth of London, but all such attempts have proved unavailing. The most determined of these attempts was in 1657, under the Commonwealth, when an Act was passed which inflicted a fine of one year's rent upon all builders and occupiers of houses which had been erected within ten miles of the City Wall since the 25th day of March, 1620, and further directed a fine of £100 to be levied on all persons who should erect " Any dwelling-house, out-house, or " cottage within the limits mentioned without assigning four " acres of ground to every such dwelling-house, &c., respectively." In 1757 when what is still called the New Road from Paddington to Islington was made, the Building Act provided that no house should be erected within fifty feet of the road, showing that in the days of George II. our legislators had some sense of the necessity for checking overcrowding of houses. This law with respect to the New Road has been flagrantly broken, however, dozens of times, and since then Moorfields has been built upon and the Drapers' Gardens in the City has been covered with offices.

Our modern methods of water-supply and filth-disposal have given a fatal facility to the overcrowding of houses, an overcrowding which ought if possible to be checked.

In addition to the scientific building regulations, I think the incidence of local taxation might be regulated so as to check overcrowding. Houses should be rated in proportion to the cubic contents, and open spaces round houses should be very leniently dealt with when valuing for rating purposes.

I think the whole of the sanitary rates should be levied *en bloc* from the ground landlord. It is the ground landlord who makes the chief profit out of overcrowding, and it is overcrowding, more than any other condition, which sends up

the sanitary rates. Again, overcrowded districts inevitably deteriorate in value in time, and if rates were regulated by cubic contents of houses, and levied on the ground landlords, these persons would safeguard their own interests by observing due care in laying out their building plots.

Again, I think we should be careful how we abandon any customs which serve to mitigate the evils of overcrowding. We are now engaged in burning all organic refuse, and some of us are urging the cremation of the dead. I hold very strongly that the proper destination of all organic refuse, including the dead body, is burial, and that the necessity of providing land for cemeteries, and for the productive utilisation of organic refuse, is a great and undoubted boon to the living, by serving to perpetuate open spaces in the neighbourhood of towns. Destructors and crematoria may be necessary, but it is impossible to regard the burning of organic refuse as a scientific method of disposal, and most certainly it must add impurities to our already too foul atmosphere. Effete organic matter of all kinds, if rationally treated (*i.e.*, superficially buried) will freshen the air and yield an increase for the living. When we wantonly burn such valuable matter we ought to feel a twinge of conscience, as we hope the servant-girl does when she lights the kitchen fire with slices of bacon.

There can be no doubt that in England the rural districts have been sacrificed for the sake of the towns, and that the free importation of food has much impoverished the agricultural classes. I believe that it is possible for the towns to materially help the agriculturist if they will make some serious attempt to supply him with organic manure at a cheap rate. If this is to be done the refuse matter should be intelligently dealt with and sorted. A mixture of garbage, chemicals, broken bottles, and clippings of tin, is of no use whatever until it has been sorted. It is easy to put it all into a furnace, but an intelligent and properly-instructed person would do something better than that. The most productive ground in the whole country is probably that devoted to market gardening round London, and the reason for this is to be found in the fact that stable dung is to be got from London very cheap indeed—almost for nothing. I have it as a fact from more than one market gardener near Isleworth that these gardens take habitually sixty or seventy tons of dung to the acre per annum, and that hungry land is able to consume as much as two hundred tons per acre. It is to me an astonishing thing that no London parish has had the enterprise to arrange for the systematic carriage of its organic refuse into the country by trains, and the establishment of a farm colony for its unemployed. These market gardens produce a

prodigious amount of food, and pay (as compared with farm-land) very large weekly sums in wages, for they employ a great many hands even in the depth of winter.

When in spring the train runs through these gardens all ablaze with blossom and redolent of wallflower, with rows of men and women busy planting, or hoeing, or weeding, or gathering, and ultimately as it enters London pulls up opposite a gaunt enclosure with a furnace in the middle and a despairing notice on a big spoil heap, that clinkers will be *given* away, it is impossible not to make comparison between the *right* as opposed to the *wrong* use of refuse. And if Trafalgar Square should happen to be filled with unemployed one is still further driven to the reflection that possibly such gatherings are but an illustration of the old proverb that "wilful waste makes woeful want," and that one of the legitimate occupations of these unemployed should be to turn the organic refuse of the city to productive purposes, and so extract work and food and wages from their only source, the earth, and in so doing maintain open spaces near cities, to regenerate the freshness of the air and keep the inhabitants to some extent apart.

Sir Thomas Crawford, K.C.B. (London), thought the paper an able review of some Sanitary points pressing on the people, and that if the remarks lead to finding remedies for the evils arising from fogs it would be very valuable. He was fascinated by Dr. Poore's reference to the advisability of every inhabited house being surrounded by four acres of ground, which reminded him of the famous three acres and a cow, a state of things which would be very advantageous, but would, he was afraid, be impossible. Dr. Poore had pointed to a growing danger, namely, that of substituting elevated crowding for surface crowding. He (Sir Thomas Crawford) doubted whether this substitution would prove a remedy for overcrowding. He was himself in favour of splitting up the crowded portions of the City by wider streets, and advocated the increase of open spaces, but he did not agree with Dr. Poore in the increase of burial grounds. He concluded by proposing a hearty vote of thanks to Dr. Poore for the very able paper which he had placed before the meeting, and remarked on one important point which Dr. Poore had raised, namely, the danger of being led away by statistical figures, which, taking it on the average, were apt to make London appear as a healthy place, whereas many places in London were very unhealthy.

Mr. G. J. Symons, F.R.S. (London), said it was difficult to decide on the most important point raised by the Lecturer, as he had given so many. He thought that the London County Council had already

enough to do without undertaking the fog question. He thought that London fogs were not more frequent or opaque now than they were forty years ago, he having vivid recollections of some splendid specimens when a boy, but he thought they were becoming dirtier. He said that the supplanting of grass in London by pavement had tended to counteract other causes of the increase of fogs. He cited an experiment on the blackness of fogs he had made at Camden Square. At 3 o'clock in the afternoon of a day on which there was a black fog, he had been unable to distinguish white papers on a table near the window from the black leather covering of the table itself, whereas on an ordinary day it was possible to do so at 10 o'clock at night. He remarked on the distance blacks would travel. Referring to "The Doom of the Great City," he said the theory of this pamphlet was that carbonic acid had increased to such an extent that everybody died where they were. He pointed out the fact that in Manchester, owing to the amount of sulphur in the air, umbrellas had the reputation of lasting a shorter time than elsewhere; and as a good illustration of the dirty state of the atmosphere, remarked on the distance and with what clearness street lamps were visible after a good shower of rain as compared with after there had been no rain for weeks. Illustrative of the thickness of the atmosphere he said there were three prominent objects situated, two within a quarter of a mile of his house, and the third one mile away; and that in winter even the two of these were visible only about two days in a month. Sunshine in London was certainly on the decrease, as evidenced by the fact that roses would not now grow in the Botanical Gardens, and that whereas he (Mr. Symons) had ripe grapes on the walls of his house some time ago, none would ripen there now. He had great pleasure in seconding the motion.

Mr. Capper (London) spoke of the advantages to be derived from the use of anthracite coal. He personally had been using it for years and found it much cheaper than any other coal. It could be easily ignited with a gas poker. He thought that if the blackness were to be eliminated from fog it would be a great addition to health, and it would not interfere with labour. He thought that houses were being built too high for coal storage, and were outgrowing their cellar accommodation. He recommended anthracite coal, as it gives no fumes, can be fingered without harm, and creates no dust. It burns slowly, and can be obtained already broken up, and burns much longer. He recommended that a trial should be given it as a means for diminishing the blackness in fog.

Dr. J. F. J. Sykes (London) raised the question of the difference between the effect of inhaling vapour and smoke. In inhaling a cold vapour it takes the heat away from the lungs, whereas a pea-soup fog chokes one. Kinds of fogs vary from moist vapour to dense smoke, hence the difficulty of comparison. He stated that there were plenty of vapour fogs which did little harm, and thought that the stagnation

of the air and not the vapour was the cause of harm. He stated that the density of a London fog could be gauged by the horizontal movement of the wind. It was a curious fact that the Strand should have such a high death-rate, seeing that there was such a large open space in front of the district, namely, the river. He thought that the front space of houses should increase with their height. He said that Medical Officers of Health have no standard of light and air required by human beings. He thought this was very unfortunate, and was of opinion that it should be somewhat as follows:—No habitable room that does not possess a window to which light can gain access at least at an angle of 45° to the sill should be considered healthy. He pointed out two things overlooked by Dr. Poore, which would prevent animal refuse from being carried out of London, as he had suggested, viz., the cost of transport and of labour. He was afraid that anthracite coal would not improve matters. He advocated the use of gaseous fuel, as its fumes diffuse more rapidly than the smoke of coal. The distinction between these two is apparent, if one takes the instance of a Russian vapour bath and a room in which there is a smoky chimney. Smoke requires to be blown away, whilst gases diffuse and condense.

Sir Douglas Galton, K.C.B. (London), said there was a point in the paper read with which he did not agree, namely, that high buildings were as insanitary as overcrowded low houses on the level of the ground. With regard to the Strand, he said that the district is cut off from the river by high houses and densely-populated districts. He said the reason why the death-rate in model lodging-houses was less than in ground crowded houses is that there is a free circulation of air in and around these artisans' dwellings which was impossible in the overcrowded ground houses. Referring to anthracite coal, he thought that better ventilation was produced by fires which produced flame than by using anthracite coal. With gas and anthracite coal one is liable to get carbonic-oxide back into the room, which is dangerous.

The vote of thanks to Dr. Poore for his paper was then put to the meeting, and carried with acclamation.

Dr. G. V. Poore (London) acknowledged the honour done him by the vote of thanks, and desired to express his sense of appreciation of the attention given him. He said that London should not be taken as an example by places which had a better chance, and referring to overcrowding said that with regard to air-borne contagia the danger of infection in the open air was slight, whereas under a common roof it was enormous. He said that he did not believe that the health of a city was improved by boulevards, as they only pushed everything on either side and created greater overcrowding under a common roof. Paris was a case in point. With regard to high buildings, he cited the case of the Magazin du Louvre in Paris, for when the epidemic of influenza prevailed 1,000 people in that place had it.

THE HOUSING OF THE WORKING CLASSES.*

By H. PERCY BOULNOIS, M.Inst.C.E.

Read at the Sessional Meeting, March 8th, 1893.

"The sins of the fathers shall be visited upon the children." The sins of the speculative builders of the past are being now visited on the ratepayers of to-day.

In most of the great towns of this country, owing to the rapid growth of their populations, habitations had to be provided; unfortunately, when the sudden rush took place from the agricultural to the urban districts, due to the discovery of steam power and the consequent centralisation of manufacturing industries, there were few, if any, laws regulating the erection of dwelling-houses, and, as a result, the greatest possible accommodation was provided on the least possible areas of building land; and as the more well-to-do citizens left their town houses, these were bought and converted into "rookeries" by the speculators of the day. In many towns, courts or alleys sprang up, with back-to-back houses facing these narrow courts. A typical court may be thus described:—

The area on which it is built has a frontage of 30 ft. towards a narrow street, and is about 60 ft. in depth; fronting and opening on to this narrow street are two three-storied houses. under the first floor of one of these houses is a passage or tunnel about 3 ft. wide and 5 or 6 ft. high, which gives access to the court behind, although in some cases this narrow passage is not covered in, but forms a narrow, trench-like opening between the gables of the two front houses. In the court are two rows of three-storied houses, facing each other at a distance of only 6 or 8 ft., their backs being built against other houses, which in their turn face against a similar court. The houses have 11 ft. frontage, and are 11 ft. deep, including walls, with staircases inside the living rooms, and the only ventilation being that which can be derived from the windows opening into the court, which is a mere well-hole. Some sixty or seventy persons will be found living in a court of this description, which is equivalent to a population of 1,680 persons to the acre!

Such and similar buildings were the outcome of an abnormal

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* See Appendix A.

demand for cheap dwellings in towns and the dread of speculative builders, that legislation might put a stop to their harvest before they had had time to "make hay."

Another evil form of cheap dwelling is the mansion, or town house of a respectable kind converted into a tenement building or rookery. These are well known in London, and consist of large houses built close together, in which every room on every floor is let to a family, and even in some cases to more than one family in a room, where they have lived harmoniously till one of them took a lodger!

It is not necessary to dwell upon the horrors of such an abode, where the ordinary daily necessaries of civilized life are absolutely inadequate and can only be used in common with the teeming population of such dens.

In order to grapple with the insanitary court property in Liverpool, of which a description has been given and models have been shown, the Corporation about thirty years ago obtained an Act of Parliament entitled "The Liverpool Sanitary Amendment Act, 1864,"* which empowers the Medical Officer of Health to present to the Grand Jury at Quarter Sessions a schedule of any houses that he may deem unhealthy in themselves, or any court, alley, or any premises unfit for human habitation, or in a condition, state, or situation, injurious, dangerous, or prejudicial to health. If the Grand Jury concur with this presentment, after hearing evidence on both sides, the owners must either sell to the Corporation for demolition, or themselves demolish their property, and the Corporation have to pay reasonable compensation.

Failing an agreement between the Corporation and the owners as to the purchase price or amount to be paid as compensation for demolition, an arbitrator is appointed by the Local Government Board, who decides the amounts to be paid. There is one point specially to be noted in connection with this Act, which was the first of the kind ever passed by the Legislature, and that is that there is no statutory obligation upon the Corporation to provide dwellings for the persons displaced by the demolition of insanitary property, as is invariably provided for in all other Acts dealing with this question.† The Corporation, however, have always endeavoured to sell the land, where suitable, as cheaply as possible, in order to encourage builders to erect healthy dwellings thereon available for the working classes. This has been done to some extent, but, owing to the necessity for leaving more area of open space and for other reasons,

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* See Appendix B. † See Appendix C.

the accommodation provided has not been in any way commensurate with the numbers of persons displaced. For instance, up to the present date about 3,500 insanitary houses have been demolished, and only 334 six and four-roomed houses have been erected by builders, and let at rentals varying from 5s. 6d. to 6s. 6d. per week, as against 2s. 6d. to 4s. per week rentals paid for the insanitary houses demolished. It may, however, be readily understood that the demolition of such houses as I have described to you is of far greater importance than the provision of dwellings upon equivalent areas.

In some cases, in order to avoid demolition, the Corporation caused to be prepared for the owners schemes for the conversion of their unhealthy properties into sanitary dwellings; and as these proposed conversions are extremely interesting, I have prepared diagrams to explain the details. (Copies of the diagrams will be found facing page 48.)

It was found, however, that the cost of alterations, and less accommodation provided, disinclined owners to take advantage of these proposals, and they preferred to be compensated in cash by the Corporation and divert the money into other channels. It is also found that the owners of this description of property have, as a rule, no means to carry out alterations; and a great deal of it is trust property, &c., which makes it difficult to deal with, short of sale and demolition.

Under the Act, which has been thus described to you, the Corporation of Liverpool have up to the present time spent £235,000 in the demolition of 3,500 houses, but still much remains to be accomplished.

The Corporation have also carried out a scheme under the Artisans' and Labourers' Dwellings Act, 1875. An area known as "Nash Grove" was scheduled by the then Medical Officer of Health as an "unhealthy area" in the year 1875, which comprised 22,487 superficial yards (nearly 5 acres), which cost the Corporation in compensation for trades, lands, buildings, &c., £67,000, and the number of persons displaced was 1,310 or £51 per head.

Many unsuccessful attempts followed to sell the site thus acquired for private individuals or companies to erect artisans dwellings thereon. The land was offered by auction on two occasions with a modest reserve which was not reached, and consequently in the year 1885 the then City Engineer prepared plans, &c., and eventually erected a fine block of artisans dwellings, of which the following description will, I think, be interesting. The buildings are known as Victoria Square, and they are bounded on every side by streets of 60, 45, and 30 ft. wide. The site contains 9,195 yards, of which 3,924 yards are

occupied by dwellings and 5,271 yards in the approaches, and a large open quadrangle in the centre paved with asphalte, which gives abundance of air and light space, and is an excellent playground for the children. The entire area occupied by the buildings was covered with a layer of concrete 9 ins. thick, and all the streets in the neighbourhood are paved with syenite setts upon concrete; the site is thus practically impervious, with the most beneficial sanitary results. The buildings are 5 storeys in height and divided by thick party walls into 13 separate "dwellings," each of 75 ft. frontage and 36 ft. in depth. These are placed facing the quadrangle, and thus admit of a free circulation of air around them.

There are 22 tenements in each "dwelling" approached by a separate entrance from the quadrangle, the arrangements of the rooms being as follows: On the ground, first, second, and third floors there are two tenements of three rooms and two of two rooms, whilst on the fourth floor there are four two-room tenements and two one-room tenements. There are 271 tenements in all, made up as follows:—

86	3-room tenements...	... ...	258 rooms.
164	2 " " ...	... ...	328 "
21	1 " " ...	... ...	21 "
Superintendent's House...		... ...	4 "
		Total number of rooms	611

The three-room tenements are arranged as a living-room or kitchen, 13 ft. × 12 ft. 4 ins.; a large bed-room 15 ft. 3 ins. × 9 ft. 7 ins. (capable of being divided by a screen), a bed-room 13 ft. 8 ins. × 8 ft. 6 ins. The two-room tenements are arranged as a living-room or kitchen, 13 ft. × 12 ft. 4 ins., a bed-room 15 ft. 3 ins. × 9 ft. 7 ins. (capable of division as before). The one-room tenements are arranged as a living and bed-room combined, 12 ft. × 12 ft. All the rooms are 9 ft. in height.

The following table gives the floor space and cubical contents of the rooms of each tenement approximately:—

Tenements.	Living-room.		No. 1 Bedroom.		No. 2 Bedroom.		Total floor space.	Total cubical contents.
	Floor space.	Cubical contents.	Floor space.	Cubical contents.	Floor space.	Cubical contents.		
3-room tenements	160⅓	1443	146	1314	110½	994½	416	3751
2-room tenements	160⅓	1443	146	1314	...	...	306⅓	2757
1-room tenements	144	1296	...	...	...	...	144	1296

Note.—These measurements are exclusive of the sculleries, laundries, and other sanitary conveniences, of all of which the tenants have the free use.

Two water-closets are provided on each floor for the joint use of the four tenants. The dust and ashes on each floor are disposed of through ventilated shoots formed in the angle of the lobbies leading to the water-closets. A laundry is placed on each floor for the use of the four tenants, each tenant having the sole use on a fixed day, or portions of days. On each side of the laundry is provided a double stoneware glazed sink-trough with water laid on to each, thus giving a separate sink to each tenant. Gas is laid on to all the tenements, and the supply is under the control of the superintendent. The rents are as follows :—

Three-roomed dwelling on the ground, first, or second floors, 5s. 6d. per week, and a two-roomed dwelling, 4s. 3d. per week. On the third and fourth floors a three-roomed dwelling is 5s. per week, two-roomed dwelling 3s. 6d., and one room 2s. per week. The rent covers all charges, including rates, gas, and water.

The class of persons who occupy these dwellings is better than that which was displaced, as the following table of the occupations and wages of the tenants of a block taken at random will show :—

Occupation of Tenant	Wages per week.	Occupation of Tenant.	Wages per week.	Occupation of Tenant.	Wages per week.
Saddler	31s.	2 Millers......	30s. & 28s.	Cooper	30s.
Coach Builder..	26s.	Printer	26s.	Carter	25s.
Weight-taker ..	25s.	Labourer ...	22s.	Labourer	20s.
Barman	20s.	Porter.........	20s.	Labourer	18s.
Sailor	20s.	Lamplighter.	19s.	Cooper	19s.
Labourer	18s.	Labourer ...	17s.	Porter	17s.
Charwoman ...	8s.	Charwoman .	5s.	Cigar Maker (female)	12s.

These persons are all of the real wage-earning class, whereas the majority of those displaced were no doubt of the class called the "submerged tenth," and there is every probability that the houses vacated by the persons now occupying the Victoria Square Dwellings have become occupied by the class of people displaced by the demolition of the condemned houses.

(Some drawings illustrative of the Victoria Square Dwellings were exhibited to illustrate this portion of the paper.)

The Corporation have also erected another block of buildings on the site of this formerly "unhealthy area," known as "The Juvenal Dwellings," which are only separated from the Victoria Square Dwellings by a street, 45 feet in width,

which runs between them. These dwellings are of the type of Labourers' Dwellings, and consist of one large block facing Cazneau Street, containing 50 tenements, with three blocks behind containing 50 tenements, making a total of 100 tenements and one shop. There are only one and two-room tenements and no three-room tenements in these blocks, and the rents are as follows:—4s. and 3s. 9d. per week for two-room tenements according to height of floors, and 2s. 6d. per week for one-room tenements, all inclusive of gas, taxes, &c. The roofs have been kept flat on which the washhouses were constructed. The block plan shows the respective positions of these buildings, with plans of the arrangements of the floors in the Juvenal Buildings.

The population contained in the dwellings I have described are as follows:—

	Males.	Females.	Total.
Population of Victoria Square Dwellings...	485 ...	501 ...	986
,, ,, Juvenal Dwellings	135 ...	132 ...	267
Totals	620 ...	633 ...	1253

The cost of the Victoria Square Buildings was about £58,000, that of the Juvenal Buildings £12,946, or a total of £70,946 for buildings, to which must be added the cost of the land, £67,000, making a total of £137,946 expended in carrying out these schemes. From this amount must, however, be deducted the sum of £2,797, the value of some surplus land which was sold to a builder, who erected fifty small four and five-room self-contained cottage dwellings thereon, which reduces the total cost to the sum of £135,149. The annual costs, consisting of maintenance, rates, taxes, gas, water, superintendent's salary, &c., amount to £1,300 per annum for the Victoria Dwellings, and £350 for the Juvenal Dwellings. The income from rents is £3,000 per annum from the Victoria Dwellings and £895 from the Juvenal Dwellings, thus leaving a net surplus of £2,245 per annum to meet the interest and sinking fund on the capital sum of £135,149, which it is evident is not sufficient for that purpose.

The Corporation however decided, and I think justly so, that the amount paid by them in compensation for the acquisition of the land, which averaged £3 per square yard, did not represent its commercial value when cleared of buildings, &c., and they have consequently assessed its value at £1 2s. 6d. per square yard, which reduces the cost to £25,298 instead of £67,000, its real cost; and taking it at this value, less the £2,797 received for the surplus land, the net return since the year 1888 has

been estimated to produce about $2\frac{1}{2}$ per cent. on the assumed capital expended.

It is evident that in dealing with this question a considerable loss must necessarily fall upon the ratepayers, as it is impossible to acquire land already densely crowded with rent-producing buildings at any such price as would make it possible to erect remunerative dwellings thereon, and this fact should never be lost sight of in dealing with this highly important problem of the displacement and re-housing of the working classes on or near the sites of their old homes in towns or cities.

It will be seen from the figures that have been given that the loss to the ratepayers of Liverpool was £32 per head of the population of 1,310 displaced; and in London, where the operations of similar Acts have been enforced, as much as £60 per head has been lost, this loss representing part of the penalty which the thrifty taxpayer of to-day has to bear in endeavouring to remedy the mistakes of the past.

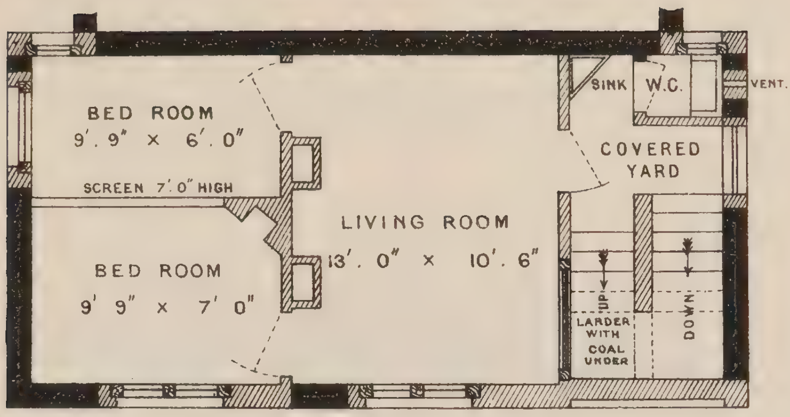
The problem that has thus been forced upon the present generation is of vast proportions, and has puzzled statesmen, politicians, philanthropists, political economists, and sanitarians for the last fifty years. It is a problem which affects the industrial, social, intellectual, and sanitary condition of the working classes, and the prosperity of the industry of the country. It resolves itself into how much rent can the wage-earning classes afford to pay, and can the small wage-earning class be properly housed without State or philanthropic interference? and how far is such interference or assistance justifiable without disastrously affecting that self-reliance, which is the mainstay and backbone of a community? and how far is such interference contrary to the laws of political economy, and detrimental to the progressive evolution of the race?

Even if help towards comfortable and sanitary dwellings for the "submerged tenth" and working classes is deemed advisable, the best methods for this accommodation have by no means yet been satisfactorily settled. If it is necessary to find accommodation for the working classes near their work, and to increase our cities vertically as well as horizontally, then I think the problem resolves itself into the following heads:—

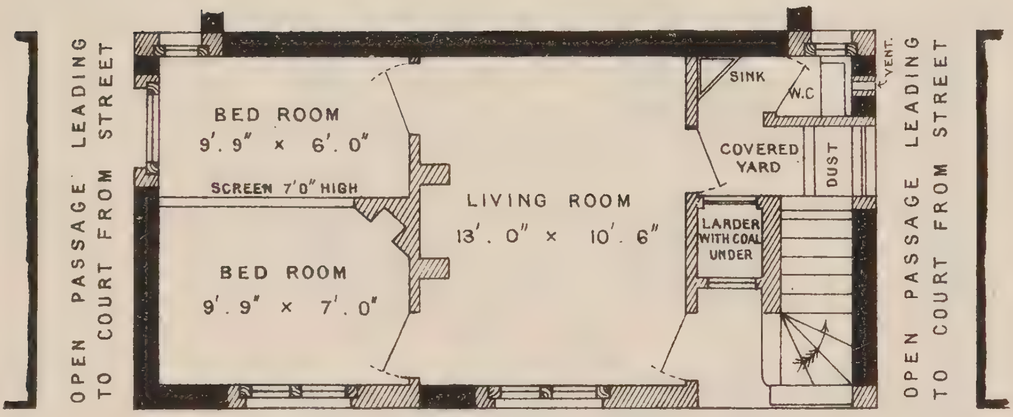
(1) That the rental paid must be the lowest that is possible for the maximum of accommodation.

(2) That the situation of the dwelling shall be convenient for the daily avocations of the occupiers.

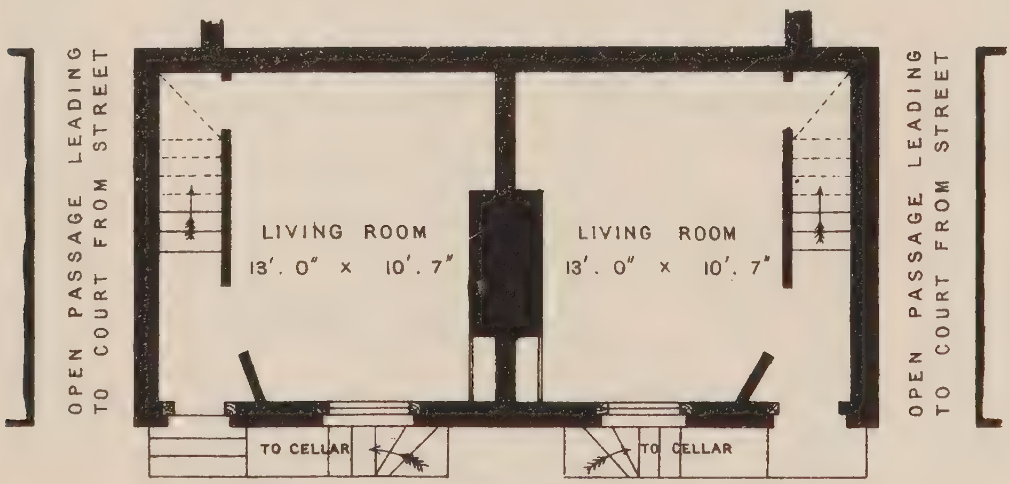
(3) That the dwellings shall be substantially and sanitarily constructed on healthy sites.



Upper Floor Plan.
(AS PROPOSED.)



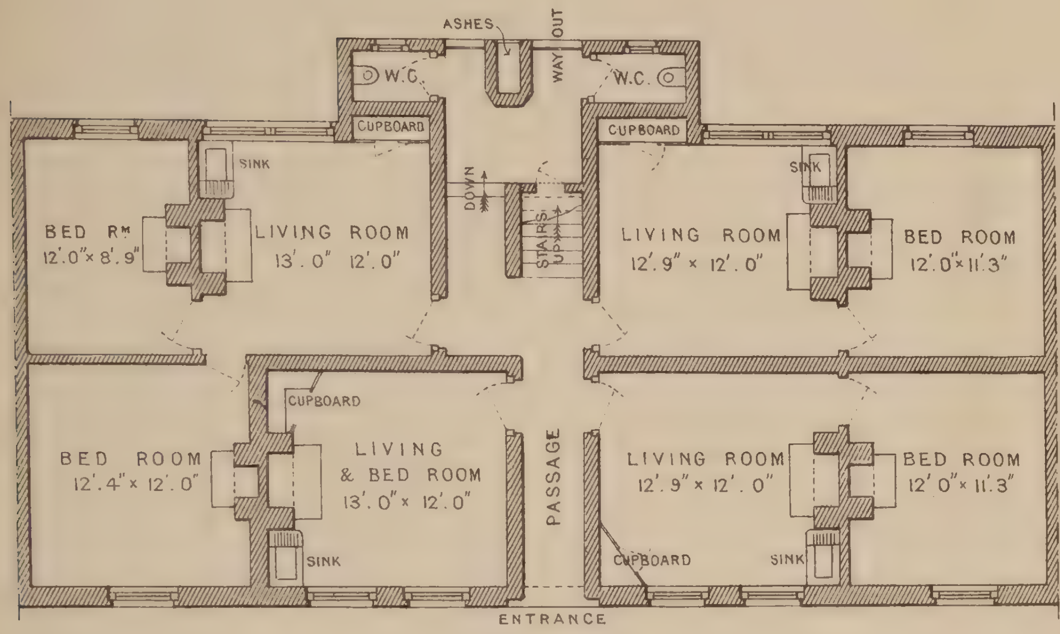
Ground Plan.
(AS PROPOSED.)



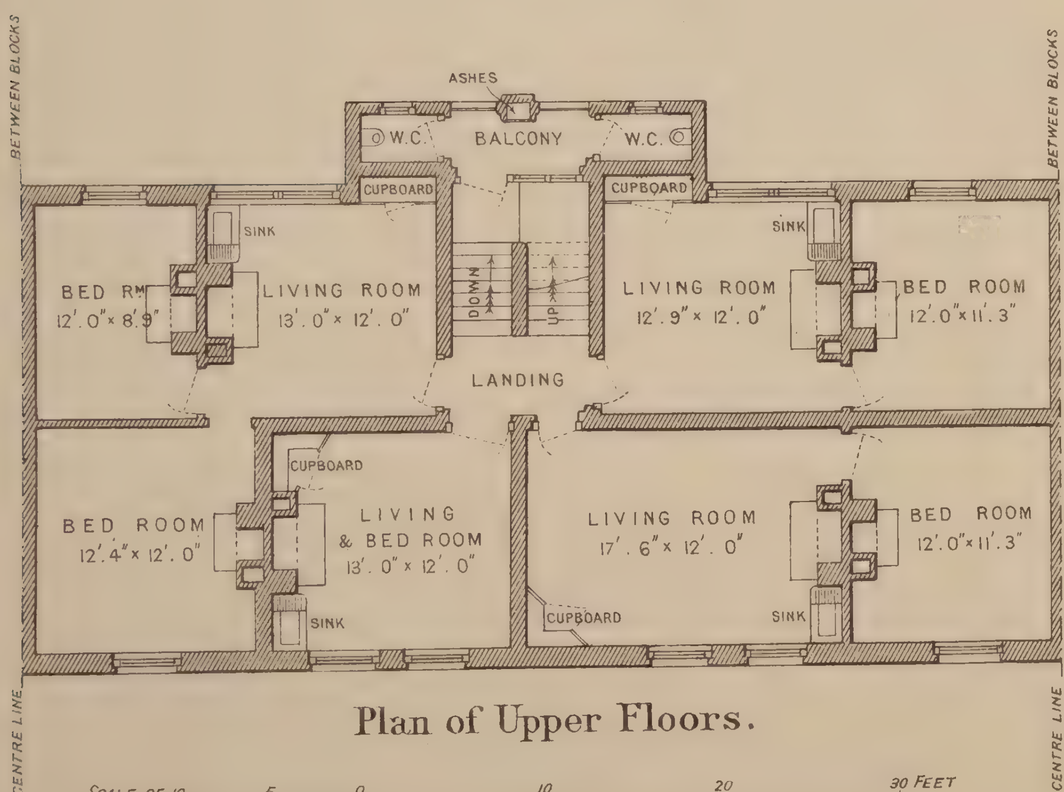
Ground Plan.
(AS EXISTING.)

PROPOSED CONVERSION OF FRONT HOUSES INTO
TENEMENTS, IN FLATS.

SUGGESTED PLAN FOR LABOURERS DWELLINGS.



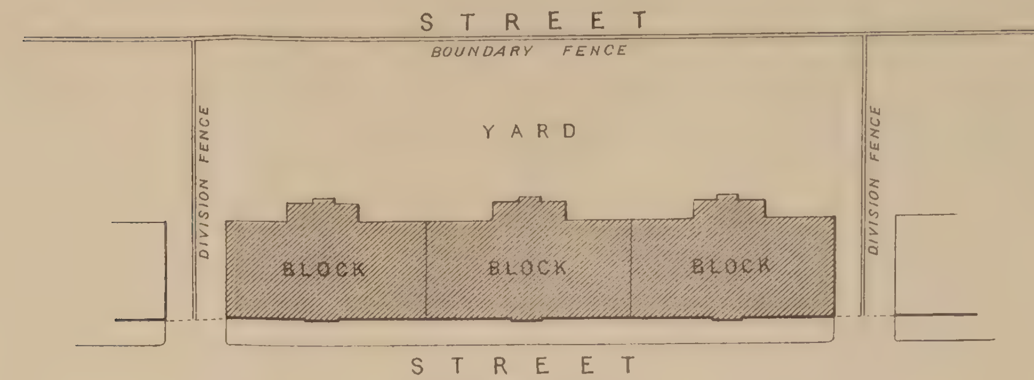
Ground Plan.



Plan of Upper Floors.

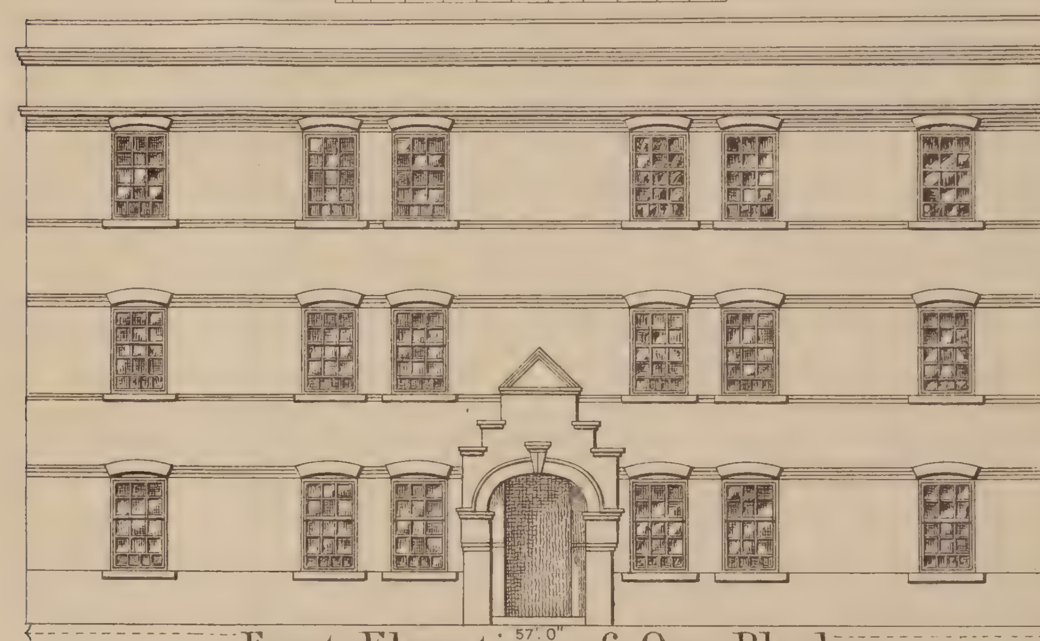
SCALE OF 10 5 0 10 20 30 FEET

SUGGESTED PLAN FOR LABOURERS DWELLINGS.

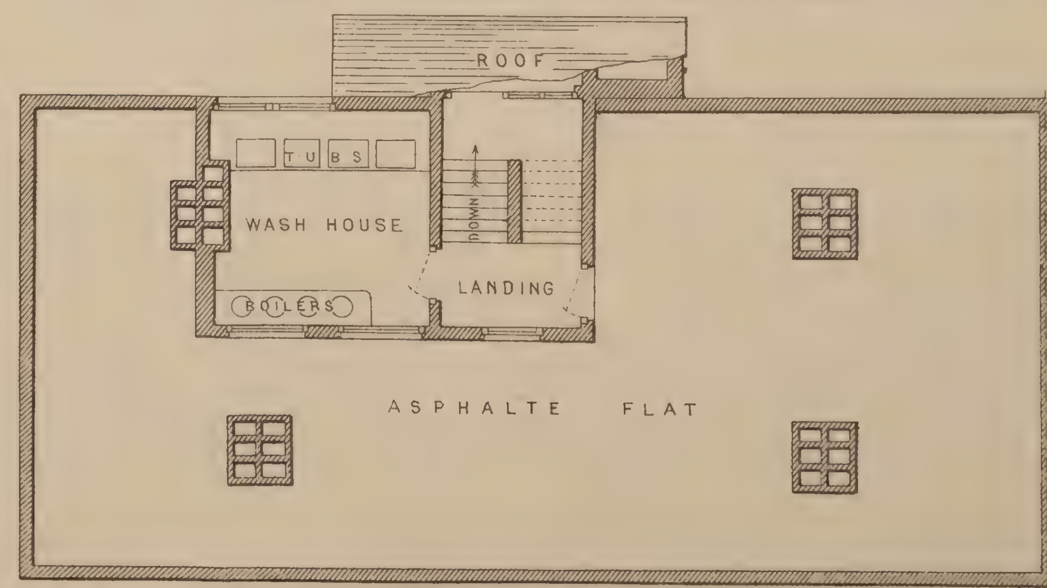


Block Plan.

SCALE OF 10 5 0 10 20 30 40 50 60 70 80 90 100 FEET.



Front Elevation of One Block.



Plan of Roof.

SCALE OF 10 5 0 10 20 30 FEET

(4) That each dwelling in the block shall be to some extent isolated, and communion avoided as much as is possible under the circumstances.

An analysis of the above requirements show that in order to obtain low rentals, inexpensive materials and very little ornamentation must guide the design, and that the site must have been obtained at a low price. I have caused to be prepared some diagrams of a class of workmen's dwellings which are, I think, somewhat superior to the large high blocks of dwellings. With regard to convenience of site, this is of course a great difficulty; cost of land, possibility of securing a sufficient area, the value of the area for other purposes, such as manufactories, &c., have hitherto proved considerable obstacles, except where the local authority has been prepared to lose capital in the purchase of the land.

That the dwellings shall be substantially and sanitarily constructed is of primary importance,* when we consider the effect of massing human beings together in large numbers under the same roof for any considerable period of time; for unless very special precautions are adopted, these dwellings may gradually become saturated and soaked with human emanations, and in the event of an epidemic breaking out considerable difficulty would be experienced in checking it.

In the *Times* of the 15th November of last year, in an article on English Ports and Cholera, the following appeared:

"Probably more has been done in the way of slum improvements than in any other line of late years, but it is feared that we have in many cases only laid up worse trouble for the future, for the vast structures known as 'model' dwellings are often merely models of rotten construction and jerry building of the most shameless order. One of the most experienced sanitary inspectors in London, who has seen the old and the new in a poor district, and has now under his charge forty of these structures, each containing from 200 to 4,000 persons, observed to me the other day: 'In a few years these buildings will be the curse of London, they are worse than the old slums we had before them.'"

These are serious forebodings from a leading journal, and, if true, point to the fact that the solution of the proper housing of the working classes has not yet been reached.

Nearly all the legislation of the past upon this question has

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* See Appendix D.

been with a view to replacing upon any area the population removed therefrom, the reasons for this obligation being, no doubt, the desire to incommode the population as little as possible, to avoid any great change in the rateable value of the area dealt with, the desire to study the interests of the small shop-keepers in the neighbourhood, and lastly, not to disturb or extinguish voters.

I think it is a matter well worthy of this meeting to discuss the question from the point of view as to whether it is a really sanitary measure to perpetuate crowded areas, even under better and more healthy circumstances; and if it would not be wiser to discourage this centralization of the population into towns and cities, and endeavour on the other hand to provide suitable, self-contained, and more interesting habitations for the real working classes in the suburbs, leaving the "submerged tenth" to be dealt with in Municipal or State common lodging-houses.*

If there is a necessity, as it appears there must be, for the ratepayers' pockets to contribute to this problem, if it is to be carried into partially successful operation, and if, as I have shown, this is to cost the capital sum of from £30 to £60 per head, could not this money be more usefully applied in making arrangements for the cheap carriage of the working man to his suburban cottage, which could be built far cheaper than in a city, and have also a garden and plenty of space around it? Cheap means of locomotion have grown rapidly in the immediate past, the merchant and the shopkeeper no longer live close to their work, why should the labouring classes? I would suggest that a *boná fide* working man should be carried by train, tram, or 'bus at State-aided fares; that he should live in a house on the hire-purchase-system, away from the squalid surroundings of even the most palatial block of artisans' dwellings, and by this means his personal self-interest and self-reliance would be strengthened instead of deteriorated as it is by such communism as he is forced into under the "block" system; and with the prospect in view of one day becoming a freeholder he would be more likely to become a peaceful, law-abiding citizen, with a real stake in the interests of his country. The law should be made to deal with insanitary dwellings, either as areas or any premises unfit for human habitation, in a summary manner. No one is allowed to sell poisonous food, no one should be allowed to let unhealthy dwellings; they should be condemned

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* See Appendix G.

and demolished, or closed against the possibility of letting them as habitations unless the owners consented to alter them in accordance with modern sanitary requirements.

These views may be considered as utopian, but I believe they are the real solution of the problem, and they are shared by some of those who have given this question their careful consideration.*

Much has of necessity been omitted from this short lecture, as the time at my disposal naturally curtails many points which might be raised upon this debateable question, but I have added several Appendices, which may be useful for reference. I have omitted all reference to the latest legislation on the subject, and the effect of the Housing of the Working Classes Act, 1890 (53 & 54 Vic., Chap. 70), which has practically superseded the thirteen or more Acts which preceded it.† I have omitted all details of the necessary points to be considered in the proper arrangements for the construction of artisans' dwellings, and of their management after erection.‡

I have omitted any mention of the successful operations that have been carried out in many towns, London included, in connection with the establishment of Corporation Common Lodging Houses, which seems to be a wise, economical, and effectual solution of some portions of the problem,§ in which direction London and Glasgow have set good examples; and I have abstained from quoting any statistics of what has been done throughout the country towards the erection of model artisans' dwellings or otherwise.||

In conclusion, let me summarise what I have endeavoured to convey by this paper:

(1) The need for some action owing to the overcrowding of our urban districts, arising from special causes.

(2) The magnitude and difficulties of the subject.

(3) The impossibility of complying with the Acts, except at considerable loss to the ratepayers.

(4) The action that has been taken in connection with the question by the Corporation of Liverpool.

(5) A description of how that work has been carried out.

(6) That if the "Block" system is right, then great care must be exercised as to healthiness of site and construction.

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* See Appendix E.
† See Appendix F.
‡ See Appendix D.
§ See Appendix G.
|| See Appendix H.

(7) That it is impolitic and insanitary to try and replace on the same area the displaced population.

(8) That if State interference is not mischievous it should be used in the direction of spreading and not centralising the population.

(9) That the working man should be encouraged to become the owner of the house he occupies.

(10) That the so-called "submerged tenth" should be provided for by State or Corporation Common Lodging-Houses.

I trust that this paper may add something to the already voluminous literature upon this interesting social and economic question.

Appendix A.

The Law attempts to define "Labouring Classes" as follows:

"For the purposes of this section the expression 'labouring class' includes mechanics, artisans, labourers, and others working for wages; hawkers, costermongers, persons not working for wages, but working at some trade or handicraft without employing others, except members of their own family; and persons other than domestic servants whose income does not exceed an average of thirty shillings a week, and the families of any such persons who may be residing with them" (Cheshire Fines Committee Act, 1893, Sec. 5).

Appendix B.

Particulars of the Liverpool Sanitary Amendment Act, 1864, and the subsequent Statutes amending that Act:—

The principal Act provides that if the Medical Officer of Health shall find that any court,* alley, or any premises is or are unfit for human habitation, or in a condition, state, or situation injurious, dangerous, or prejudicial to health, he shall report the same; and if four householders report to the Medical Officer of Health that disease exists in any court or alley, he is required to make an inspection. The report of the Medical Officer of Health is to be made in duplicate, and the principal Act requires that he shall deliver one report to the Town Clerk and the other to the Clerk of the Peace. An important

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* The term "court" includes a street having an entrance of less than 40 feet in width.—Act of 1864, Section 3, as amended by the Provisional Order of 2nd May, 1879.

amendment was made in the principal Act by the following sections of the Liverpool Improvement Act, 1882:—

Sec. 78. A report by the Medical Officer of Health, under the Liverpool Sanitary Amendment Act, 1864, as to the condition of courts, alleys, and other premises need not be made and signed in duplicate, and a copy need not be delivered to the Clerk of the Peace unless the Corporation specially so direct.

Sec. 79. Where the Medical Officer of Health has made a report to the Corporation under the Liverpool Sanitary Amendment Act, 1864, the Corporation may from time to time (whether or not a copy of the report has been delivered to the Clerk of the Peace, or a presentment has been made under the said Act) acquire by agreement all or any of the premises included in such report, or any estate or interest therein or in any part thereof; and any premises, estate, or interest so acquired by the Corporation may be sold or otherwise dealt with, and disposed of in like manner as land and premises acquired by them under the Liverpool Sanitary Amendment Act, 1864, and Section 26 of that Act shall have effect accordingly. Any moneys which the Corporation are for the time being authorized to borrow or apply for the purposes of the Liverpool Sanitary Amendment Act, 1864, may be borrowed or applied by the Corporation for the execution of this Section.

Sec. 80. Nothing in this Act shall be construed so as to impair, or prejudicially affect, the procedure by way of presentment under the Liverpool Sanitary Amendment Act, 1864, in cases where the Medical Officer of Health, with the sanction of the Corporation, delivers a copy of any report under that Act to the Clerk of the Peace.

It will be observed that where any property mentioned in the Report of the Medical Officer can be acquired by agreement, no further preliminary steps need be taken by the Corporation after the delivery of the Medical Officer's Report. If, however, it is desired to take any property by means of compulsory purchase, the following steps have to be taken under the principal Act:—

(1) A copy of the Report has to be sent to the Clerk of the Peace, and a copy to the owner of the premises, to

whom a notice has to be given that the Report will be taken into consideration by the Grand Jury at the next Sessions.

(2) The Clerk of the Peace is required to lay the Report before the Grand Jury to make a presentment thereon, according to their view of the requirements of the case.

(3) The Clerk of the Peace is then to send a copy of the presentment to the Town Clerk, whose duty it is to lay it before the next meeting of the Council.

(4) The Council are required to forthwith order the City Engineer to proceed in the matter, and he is directed to survey the premises, and to prepare a plan and specification.

(5) When the plan and specification have been prepared the City Engineer gives notice to the Town Clerk.

(6) The Town Clerk is then required to forward a copy of the presentment to the owner of the premises, and to inform him when and where the plan and specification may be inspected.

The owner has the right of appeal against the presentment to the next Quarter Sessions, and that tribunal is empowered to make an order in the matter. The Act also provides for an appeal to the Queen's Bench. Within three calendar months after the service upon him of the notice the owner is required to signify in writing whether he is willing to effect the works, or whether he requires the Corporation to purchase the premises.

If the owner elects to effect the works and makes default, the Corporation are empowered to execute them and to reimburse themselves by the sale of the old materials and to recover the balance, if any, from the owner. If the presentment requires the total demolition of any premises the buildings are to be removed, and it is obligatory upon the Corporation to pay compensation, including the value of the buildings and the site thereof, unless the owner shall desire to retain the latter, in which case he will not be able to build upon it without the consent of the Council.

In cases of compulsory sale the steps prescribed in the Lands Clauses Act have to be taken.

Appendix C.

With regard to the provision to be made for re-housing the population displaced it is necessary for the scheme to "provide

for the accommodation of at least as many persons of the working class as may be displaced in the area with respect to which the scheme is proposed in suitable dwellings, which, unless there are any special reasons to the contrary, shall be situate within the limits of the same area, or in the vicinity thereof" (38 and 39 Vic., chap. 36, sec. 5).

It is true that some amendments to this Act partly repealed this clause, but although the legal compulsion of the provision of "suitable dwellings" did not remain so severe the moral obligations remained unaltered.

Appendix D.

A few points to be considered in connection with the erection of Blocks of Artisans' and Labourers' Dwellings.

(1) Healthiness of site.
(2) Open surroundings and wide impervious streets.
(3) No possible stagnation of air.
(4) Substantiality of buildings and best materials in construction, commensurate with economy.
(5) Perfect plumbing and best sanitary appliances.
(6) Prevention of spread of fire and facilities for escape.
(7) No basements or cellars.
(8) Each tenement to have only one door to landing.
(9) Isolation of each tenement.
(10) Perfect ventilation of each room.
(11) Separate W.C.'s, sinks, &c., to each tenement.
(12) Heating and lighting to be included, if possible, in rent.
(13) Ample provision for washing and drying clothes.
(14) Ample provision for quick removal of dust and other dry refuse.
(15) Simplicity of cooking ranges.
(16) Rules for prevention of overcrowding, sub-letting, &c.

(See also Appendix J.)

Appendix E.

Working Men and their Homes.

At a Political Conference held in Sheffield on December 13th, 1892, the Hon. C. Stuart-Wortley, M.P., in the chair, there being also present Mr. Akers Douglas, M.P., Sir E. Ashmead-Bartlett, Sir F. Dixon-Hartland, M.P., Sir F. Seager Hunt, M.P., Sir A. Rollit, M.P., and others;

Mr. T. Wrightson, M.P., moved—"That the time has come when Parliament may well afford facilities for the acquirement

by working men of their own homes." He said he wished to bring forward a plan by which the credit of the country could be utilised for the benefit of working men, by making available a large amount of cheap money for the purpose of building or purchasing dwelling houses for the working classes. His proposal was that municipalities and other local authorities should be empowered by Act of Parliament to borrow from the State certain moneys every year, in some reasonable proportion to their rateable value and their building requirements, and that they should lend the same to the *bonâ fide* working man who desired to purchase or build a dwelling house for his own occupation, and this on the easiest possible terms, which, without profit to the municipality, would cover the obligation to the State and the bare cost of administration.

Sir Albert Rollit, M.P., seconded the resolution, and expressed his sense of the value of our municipalities, pointing with pride to the fact that the Marquis of Bute had taken office as Mayor of Cardiff, and that Lord Tredegar had also taken an active and useful part in local administration. The proposal of Mr. Wrightson was on the lines of social and political development.

Whilst this paper was in course of preparation I find that a Bill, entitled "*A Bill to secure the provision of Cheap Trains in London*," will be brought before this Session of Parliament by Sir John Blundell Maple, Sir Algernon Borthwick, Mr. Bucknill, and others, which states in the Preamble that "having regard to the congested state of the population in the central and other parts of the administrative County of London, it is expedient to afford greater facilities for the residence of London Working Classes in the outer suburbs."

This Bill, if carried, would make it obligatory on every Railway Company, having a terminus in London, to issue, by all Workmen's trains arriving at that terminus in the morning before eight o'clock from any Station within twenty miles of the terminus, daily Return Tickets at fares not exceeding those specified in the following scale:—

Distance between Station and Terminus.	Maximum Return fare.
Not exceeding five miles...	2d.
Exceeding five miles and not exceeding ten ...	4d.
Exceeding ten miles and not exceeding fifteen...	6d.
Exceeding fifteen miles and not exceeding twenty	8d.

Such tickets are to be available for the return journey by any train departing from the terminus after five p.m. on the day of issue, and after twelve noon on Saturdays. There is a clause providing that the Board of Trade may interfere supposing the Company refuse or neglect to comply with the order in the

manner provided in the "Cheap Trains Act, 1883." The Bill does not in any way propose that the fares should be State-aided, but it is suggested that the Railway Companies alone should bear the cost of the carriage of workmen to and from their work at reduced fares.

Appendix F.

Housing of the Working Classes Act, 1890.

Before the Housing of the Working Classes Act, 1890 (53 and 54 Vic., chap. 70), came into force there were about a dozen Acts of Parliament of different dates dealing with this question, which were most confusing and complicated to understand and somewhat contradictory of each other. These have, fortunately, been repealed or amended, and the procedure has now been much simplified and extended, under which local authorities can close or demolish dwellings unfit for human habitation; and powers have been given for dealing with schemes on smaller scales than those contemplated by the old Acts, and the payment of compensation simplified and certain payments to occupiers, &c., authorised, and the law on the subject generally improved. For instance:—

(1) Any area may be excluded, or lands may be included, as the exigencies of the case require.

(2) Approaches may be widened or opened out for the purposes of ventilation and health.

(3) Dwelling accommodation must be provided for the working classes displaced by the scheme.*

(4) Proper sanitary arrangements must be provided.

(5) The scheme must distinguish the lands taken compulsorily.

(6) The scheme may be carried out by the freeholder under the superintendence and control of the Local Authority under certain conditions.

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* Where a scheme comprises an area situate elsewhere than in the county or city of London, it shall, if the confirming authority so require (but it shall not otherwise be obligatory on the local authority so to frame their scheme), provide for the accommodation of such number of those persons of the working classes displaced in the area with respect to which the scheme is proposed, in suitable dwellings to be erected in such place or places either within or without the limits of the same area as the said authority, on a report made by the officer conducting the local inquiry, may require. (53 & 54 Vic. c. 70, sec. 11, sub-sec. 2.) A local authority may, for the purpose of providing accommodation for persons of the working classes displaced by any improvement scheme, appropriate any lands for the time being belonging to them which are suitable for the purpose, or may purchase by agreement any such further lands as may be convenient. (53 & 54 Vic. c. 70, sec. 32.)

(7) Compensation for lands and interests to be based on the fair market value, due regard being had to:

(*a*) Nature and condition of property.

(*b*) Probable duration of buildings.

(*c*) State of repair.

(*d*) No improvement made to the property after publication of scheme to be taken into account.

(*e*) Evidence to be allowable as to fictitious values of rents by reason of the property being used for illegal purposes, or overcrowded.

(*f*) That the houses are a nuisance or in a state of defective sanitation, or not in reasonably good repair.

(*g*) That the houses are unfit and not reasonably capable of being made fit for human habitation.

(8) All rights of way and easements shall be extinguished on purchase of the lands, &c.

These are all very important powers, and the third part of the Act consolidates the Labouring Classes Lodging-House Acts, 1851 and 1885, and empowers Urban Authorities to provide lodging-houses for the working classes, either by purchase or renting of land, or appropriating land belonging to the authority, or to convert any buildings into lodging-houses and fit them up, or to purchase or rent from other persons existing or future lodging-houses.

Appendix G.

A Municipal Lodging-House.*

"At the invitation of the London County Council, a number of ladies and gentlemen yesterday afternoon visited Parker Street, Drury Lane, where an experimental 'Municipal Lodging-house' has been erected by the Public Health and Housing Committee of the Council. The establishment has been prepared to accommodate 326 men with lodgings. They will be housed in separate compartments, which are 8 ft. high, 7 ft. long, and 4 ft. wide. The rooms are lit by electricity. The house also contains a large general room, a kitchen, a library, a shop for the sale of cheap provisions, and a lavatory fitted with baths. Among those present were Sir Walter de Souza, Lord Lingen, Lord Monkswell, Alderman Beachcroft, Commissary-General Downes, Colonel Probyn, Mr. John Burns, M.P., and Alderman Fleming Williams. As Chairman of the Public Health and

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* Extract from *The Times*, January 26th, 1893.

Housing Committee, Alderman Beachcroft explained that in 1890 the Housing of the Working Classes Committee of the last Council made an enquiry into the common lodging-house accommodation in London. They found that there were some 900 of these houses, accommodating over 30,000 persons. The members of the Committee inspected many of the worst of these houses, as well as some of the best, and as to the worst he could only say that no words could adequately depict the misery of them. Subsequently the Committee visited seven lodging-houses in Glasgow, started by the Municipality, which were not only remunerative, but had in no way interfered with private enterprise. As a result of the investigations of the Committee, they recommended the Council to erect a model lodging-house on the Parker Street site, and the Council approved the proposal. The work of erecting the building was put out to tender, and the cost had been kept within the amount of the contract—£14,300. The furnishing had cost £1,250, and with the addition of £3,700, the value of the site, and £1,100 for architects' commission, a total of £20,350 was reached. To secure a return of 3 per cent. on this, and such a sinking fund as would ordinarily be required to replace the cost of building in 80 years, a yearly gross income of £2,450 was required. To meet this the Council had fixed the charge for a bed at 5d. a night. He concluded by defending the erection of the house, and traversing the objections which had been raised against it."

An important experiment carried out by the Glasgow Corporation has been the providing of common lodging-houses. The first experiment was made in 1870, when the Corporation opened the Drygate and East Russell Street lodging-houses; and, even in the first year, these establishments, which were on a small scale, were financially successful, the expenditure at Drygate being £181, and the revenue, £341; and at East Russell Street the expenditure was £88, and the income £163. The Corporation increased the number of their common lodging-houses, and now have seven large establishments, the latest one being opened in 1879. The large lodging-house for men, that in Clyde Street (Calton), has been opened since 1878, is a large well-built stone building, which cost about £14,000. There is a large dining-hall, and abundant accommodation in the adjoining kitchen for cooking. Each inmate is allowed the use of cooking utensils, and cooks his own food. There is a large recreation room. Each man can have the use of a small locker by depositing sixpence for the key; and the sixpence is given back on his returning the key. There is accommodation for 350 lodgers, who, in addition to comfortable, clean beds, have the use of the recreation and dining halls, the kitchen range and

cooking utensils, and facilities for washing their clothes, &c., all for the charge of 3½d. per night, or, if they wish to indulge in the luxury of an extra sheet on their bed, the charge is 4½d. per night. Each lodger has his own enclosed sleeping closet, in which is fitted up a spring wire mattress, covered with a hair mattress. The lodgers are not allowed to go up into the sleeping rooms during the daytime. The Superintendent of the Clyde Street establishment estimated the "floating" lodgers at thirty to fifty per day, nearly all the remainder being men who have no family ties or friends, and live almost constantly in the house.

A shop is fitted up at each establishment and carried on by the Superintendent, who takes the profits as part of his remuneration. All articles of food are sold in these shops at ordinary trade prices; but lodgers may, if they prefer it, purchase their food outside. A Superintendent informed the deputation that a man can live in the lodging-houses at a cost of 4s. to 5s. a week.

One of the seven lodging-houses—the one in East Russell Street—is set apart for females. The charge is 3d. per night, and 1½d. per night for a child occupying the same bed as the mother. One woman, who was in the house with three children, was charged 5d. per night, all of them sleeping in one bed-closet. A great many women lodging in the house support themselves by needle and other work, which they do in the hall, and then go out and sell it.

The Corporation Committee are considering the advisability of building a lodging-house for the accommodation of married couples.

The success of the Corporation lodging-houses has been so great that private enterprise has now taken up the work on similar lines.

The cost of the seven lodging-houses has been about £85,000.

The following is a return of the total revenue and expenditure of each lodging-house from the year of opening up to May 31st, 1890:—

	Opened.	Revenue.	Expenditure.
Drygate	1870	£26,578	£16,524
Greendyke Street	1876	£20,363	£12,151
Portugal Street	1878	£19,691	£11,163
Clyde Street	1878	£18,175	£10,854
North Woodside Road	1878	£18,186	£11,582
Hyde Park Street	1879	£18,180	£11,577
East Russell Street (Females)	1870	£6,744	£5,492

Appendix H.

From a return made in January, 1893, by the Borough Engineer of Sunderland, from questions that he had addressed to forty-eight towns, it would appear that in reply to the query "Have you under this or any other Act acquired and demolished property of an insanitary character?" only five towns seem to have taken advantage of the Acts, though a great many replied that schemes were before their Corporations with a view to adoption. Where advantage had been taken of the Acts and artisans' or workmen's dwellings erected, it would appear that the return on the total outlay was not very encouraging. The rents charged varied apparently from 2s. to 6s. 6d.

Appendix J.

Corporation of Liverpool. Labourers' Dwellings.

Rules to be observed by the tenants, in order to secure their mutual comfort.

1. Rents will become due every Monday morning, and be payable in advance, if demanded. One week's notice to quit must be given to, or by, any tenant before leaving, such notice to be given to or by the Superintendent before 12 o'clock, and on a Monday only.

2. A deposit of five shillings will be required from each tenant, which will be held as security for the repair of cracked or broken glass, loss of keys, &c., and be returned at the expiration of the tenancy, subject to any deductions for such repairs as have not been executed or of rent due, and to the terms of Rule No. 17. The decision of the Corporation Surveyor as to the amount of the deduction to be final and conclusive.

3. Cracked or broken panes of glass must be immediately repaired by the tenants. The chimneys in use will be swept, when considered necessary by the Superintendent, free of charge to the tenants, to whom intimation will be given twelve hours previous.

4. No tenant will be permitted to underlet or take in lodgers without obtaining the previous sanction of the Corporation, or to keep a shop of any kind.

5. Care must be taken that no cotton waste, cotton, or anything likely to choke the water-closet is put therein.

6. Ashes and dry refuse only to be thrown into the dust shafts. Tenants are earnestly requested to observe this regulation, which is necessary to preserve the healthiness and comfort of their dwellings. Anything likely to create an obstruction or bad smell must be put aside for the scavenger's cart, which will call daily. All liquid refuse to be thrown down the water-closet or the sink, according to the nature of the fluid.

7. Intimation must be given to the Superintendent in cases of fever or other infectious or contagious disease, and the tenant must

also agree to allow any case of infectious disease occurring in his rooms to be removed to a Hospital.

8. The Liverpool Gas Fittings Company, Limited, shall be at liberty, by their agents or workmen, from time to time, to enter any dwelling, at all reasonable hours of the day, so as to examine and, if necessary, repair the Automatic Gas Meters fixed therein, and to collect the pence deposited in such Automatic Meter.*

9. The central playground being provided exclusively for the use of the tenants, children will not be allowed to play on the stairs, in the passages, or in the laundries.

10. Passage floors, landings, stairs, closets, and laundry to be swept each morning before Ten o'clock; washed and stoned every Saturday, not later than Ten o'clock at night. The tenant at the top of each staircase, whose turn it is, shall commence to sweep, wash, &c., as far as the next floor, the tenant in turn on that floor shall do the same to the next, and so on to the basement. The tenants on each floor taking the work in turns, commencing with the one inhabiting the dwelling with the highest number. Where a dwelling or dwellings on a floor are unoccupied, the whole of the tenants using that part of the staircase to undertake the vacant duty among them. Should there be any dispute as to the cleaning or sweeping required, or as to the tenant whose turn it may be, the matter shall be referred to the Superintendent to decide, whose decision shall be final. Tenants who, in the opinion of the Superintendent, are, by age, sickness, or infirmity, unable to do their proportion of washing, cleaning, &c., may be excused, and their work must be done by the other tenants.

11. Washing must only be done in the laundry; tenants will not be permitted to use the laundries for the washing of any clothes but their own. All clothes must be dried in the laundry, and no clothes must be hung out or laid out to dry. Each tenant will be allowed to use the laundry for one day in each week in rotation, and should any dispute arise as to the day for washing, the matter shall be settled by the Superintendent. After the washing is finished the tenant shall clean up the laundry, and dry the washing boiler—this is always to be kept dry when not in use.

12. No dog shall be allowed to be kept on the premises.

13. Tenants are not allowed to paper, paint, or drive nails into the walls or woodwork, without the consent of the Superintendent.

14. No business notice or sign to be exhibited or affixed to any portion of the premises without the consent of the Superintendent.

15. The Superintendent is not permitted to accept any gratuity whatever.

16. The Corporation to be at liberty, by their agents or workmen, to enter and inspect the state of repair or cleanliness of any dwelling at all reasonable hours of the day, and to execute any repairs thereon, and to inspect and test the Gas Meters therein.

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* This is not necessary where the lighting is included in the rent.

17. Tenants who, in the opinion of the Corporation Surveyor, shall neglect to observe these rules, misuse or improperly occupy any of these dwellings, or cause or create any discomfort or inconvenience to their neighbours, shall be subject to immediate ejectment at the expiration of forty-eight hours' notice in writing, and to the forfeiture of the deposit, without remedy of any kind on account of such ejectment and forfeiture, and the Corporation shall not be liable to any claim by such tenant for damage arising from such ejectment and forfeiture.

For the mutual benefit of tenants, they are severally requested to see to the carrying out of the above regulations.

N.B.—Receipts for rents will only be recognised, which are given on special Rent Books.

Form of Application for Dwellings.

Name ....

Occupation ....

Present address ....

Number of Rooms required in house ....

Whether married or single ....

Number of children residing with parents ....

Ages of boys ....

Ages of girls ....

Do you agree to abide by the Rules? ....

Name of person to whom applicant refers ....

Applicant's signature.............

Date....................

Sir Thomas Crawford (London) said he was sure that everyone had listened with very great pleasure to the paper, and invited remarks or questions upon the subject.

Mr. Raphson (London) asked what would become of the inhabitants of insanitary dwellings while these were being demolished?

Mr. Kershaw (London) asked whether the drains in the Victoria Square Buildings were constructed in terraces, or whether each house was drained separately?

Mr. Beachcroft (London County Council) said he had listened with interest to the paper. There was one thing the author had

omitted to refer to, viz., the great difficulty of clearing areas and re-housing the population so disturbed. He asked how in future, slums that were destroyed, were to be prevented from reappearing? It was no use clearing away the present slums if fresh ones were allowed to spring up in their place. He thought that as long as London was hampered by the want of a proper Bye-Law-Making Authority, so long would this bad state of things continue. He was convinced that unless the municipality insisted that the frontage of houses should be at least twenty feet from the roadway, matters would not be improved. He advocated the London County Council prescribing how houses should be built. He agreed with the lecturer as to cheap fares on trams, trains, &c. In places where insanitary houses were demolished, there was only room for about half the people unhoused, which of course necessitated some portion of them going farther afield; and to faciliate this there should be cheap fares, not only in London but in the country at large.

Mr. Blashill (Architect, London County Council) said he concurred in nearly all the author had said. He remembered being consulted as to Cross' Act years ago, and he thought then that the obligation to re-house the population on the site of the demolition was fatal to the Act. With regard to the query as to what was done with the people while the alterations were being made, of course they spread into the surrounding neighbourhood, and hardly ever came back at all. He had known people who had been compensated for removal from one insanitary site, purposely go to another in order to get compensation again. He had known this happen three times, making it almost a trade. The result of making improvements is that the class of people removed does not come back to the same spot. He entirely concurred in the opinion that the population should be spread out more. The wealthy and commercial classes had left the central districts which they used to inhabit of old, and the poor people only lived there for the sake of the charity they could get. He thought the real way to settle the matter was to do it kindly, and not to un-house unnecessarily, and also not to promise to take the people back. With regard to fares, he thought that no State-aided fares were wanted, but that the fares would reduce themselves in time, as they had done in the past. He said he could now ride for a penny, a distance which used to cost fourpence or sixpence, and the same sort of thing would continue. He differed from the lecturer as to the advisability of the working man owning his own house. He thought it was better to move at will if necessary, and not be fixed to a certain spot.

Mr. T. Gorniot (London) said he was a working man, and knew where the shoe pinched. He thought the working man should be distributed over a larger area, which would give him an opportunity to carry out his tastes. He entirely concurred with the lecturer as to the necessity for cheap fares, and thought that no profit ought to

be made out of the working man. Regarding trains, if you did not start early, you had to pay the full fare. He thought that the cheap trains ought to be made to run at times more suitable to the working man. With regard to the benefits the working man would derive from going further out, he thought that unless he had sufficient time he would not be able to enjoy the benefits. As an example he took the building trade, which he said entailed very laborious work. One had to get up at 4.30 a.m. so as to begin work at 6 o'clock, and and then work nine hours till 5 o'clock, making it 7 o'clock or later before one could get home, thus leaving the builder no time to avail himself of the benefits which it is said he would derive from going further afield. He was strongly of opinion that the hours of labour should be shortened.

Dr. E. Willoughby (London) said that the objection to the working classes going into the country was that they would go outside of the municipality of London, and into districts where there was no proper building supervision. As an example he took the case of Tottenham, where there were thousands of jerry-built houses, and land quite undrained. Tottenham is outside the metropolis, and cannot enforce building supervision. This state of affairs generates the germs of slums. He thought the block system of houses was too exclusive in tone to be suitable for the class for whom it was intended, viz., the working man. The system, however, possessed the advantage of dryness of site and ventilation of drains, but he thought that blocks ought in future to be built under strict supervision. He said that some existing blocks were worse than the houses they had superseded. He knew of blocks where the stairs were not open, where the soil-pipes were inside, where the closets were in the lobby in the middle of the house, where no light whatever could get to them. Very often the cistern containing the drinking water was in the closet itself; in some cases the dust shoots had sliding doors opening into the living rooms, the effluvia from them being very bad, and the cause of many diseases.

Mr. Boulnois (Liverpool) in reply said: firstly, as to what would become of the people unhoused, they would of course disappear from that spot and go elsewhere. Secondly, with regard to drainage of the Victoria Buildings, this is done by means of soil pipes which are outside, as are the closets, as shown in the plan of the Victoria Square dwellings, Liverpool. He was pleased at the concurrence expressed with his views generally. He regretted the state of things at Tottenham, and could not understand how there could be no bye-laws and no inspectors there. He thought that London must be administered in a very much worse manner than the provinces. Such a state of things as pointed out by some previous speakers, would be impossible in large provincial towns such as Liverpool, Manchester, and Glasgow. Regarding the line of frontage and having this set back, he pointed out that this was a very expensive matter indeed, as the authorities

would have to pay heavy compensation if they had all re-built houses set back twenty feet from centre of roadway. Regarding insanitary property and compensation, he thought such property should be made unsaleable by law. He was obliged to Mr. Gorniot for having spoken as a working man, and with regard to the difficulty for working men to go any distance away on account of their hours; he was of opinion that the hours were too long for good labour. Work before breakfast for instance was, he said, of no value whatever and should be dispensed with.

Sir Thomas Crawford (London) said he had very great pleasure in proposing a hearty vote of thanks to Mr. Boulnois for the very interesting paper he had favoured the meeting with. The paper had been shown to be interesting by the number of speakers it had brought forth. He said he had seen a good deal of working men in some of the poorest districts of Deptford and Greenwich. He had found that men and women who are willing to work (he would not deal with the submerged tenth) find a difficulty as to how to manage with families in block buildings, staircases being dangerous and inconvenient where children were concerned. The working man liked the independence of a cottage; and he thought that insanitary cottages might be replaced by sanitary cottages. He agreed with the lecturer that every inhabited house should be made habitable, and that landlords should be compelled to make houses sanitary.

SOME GENERAL NOTES ON THE WORKING OF LONDON MAIN DRAINAGE SYSTEM.

By W. SANTO CRIMP, M.Inst.C.E., District Engineer, London County Council.

Read at a Sessional Meeting, April 12th, 1893.

WHEN asked to read a paper at a Sessional meeting of the Institute on "Experiments in the London Sewers" the author felt that the title was an impossible one, because although he had made numerous observations of various kinds in the main sewers of the metropolis, the general results, obtained under various conditions and at different times, are without that continuity so desirable in placing on record observations, which would possibly by some few persons be regarded as authoritative.

The subject of "Main Drainage," again, is almost threadbare, and although the author would perhaps be enabled to place a few new facts before the meeting later on, he could not hope to add much to the knowledge of his audience. Engineers, again, are so accustomed to deal with dry facts and figures that they become as a body singularly unimaginative, and their writings are therefore as a rule devoid of that piquant interest for the general public which alone secures popularity, and consequently a widely-spread interest in the subject discussed. If, however, a popular novelist writes an article for the papers on some really difficult problem of engineering, attention is at once arrested, and our novelist becomes a first-rate authority, even although his facts be all wrong. Such a case recently came under the author's notice with regard to the sanitation of a northern suburb, and a writer of really delightful works of fiction, who has done much in the cause of humanity, allowed his splendid imagination to play him a trick when dealing with a subject of great difficulty, and with regard to which experts are by no means agreed.

In this paper the works on the north of the Thames will be more particularly referred to, because in the first place they are under the immediate charge of the author, and he is therefore familiar with their details, and in the second place the general

principles of the works are the same on both sides of the river, the main difference being one of population, since about three million persons contribute to the sewage works of the north side as against about one half that number to those on the south.

With regard to the subject matter of this paper, the popular writer would probably say that the most noticeable result of the working of the London main drainage system is the pouring into the atmosphere of a nauseating vapour, by means of the sewer ventilator, and it must be admitted that in this direction there are some grounds for complaint. It is however most gratifying to the sanitarian to know that both the County Council and the various District Boards of Works and the Vestries, are gradually but surely converting the old defective sewers under their respective charges into effective and self-cleansing ones. It is perhaps scarcely necessary to urge that no system of sewers can approach perfection, unless the sewers rapidly discharge all the liquid and solid matters that may enter them. The first step therefore towards lessening the offensivenesss of sewer-air is to properly construct the inverts of the sewers and to employ judicious flushing where necessary. All street ventilators in unpaved roads—and in wide roads these are not necessarily objectionable—should be provided with dirt boxes in order to prevent the detritus from the surface of macadamised roads falling into the sewers and forming dams, which cause evil-smelling deposits to accumulate. In narrow roads, and in those districts in which there is little vehicular traffic and pedestrians use the roadway as much as the footways, ventilators carried up as high as possible by means of some convenient object, are most desirable, and this system is being gradually extended in London as well as in other towns.

With regard to the general question of sewer ventilation, the author's observations in the London sewers, coupled with constant inquiries among the sewer-flushers, confirm all he had said elsewhere as to the effect of the wind in causing movements of sewer-air. He had even observed cases in which large volumes of hot liquid poured into the sewers from breweries had caused a great rise in the temperature of the sewer-air without producing more than a local disturbance; there had merely been a sudden discharge of sewer-air through the nearest ventilators, but the effects have been quite local; and he is satisfied that in sewers the wind is by far the most powerful agent producing movements of sewer-air, and therefore the only one that need be recognized. Sometimes the currents are upwards, sometimes downwards, and in foggy or calm weather there is little or no movement other than that due to displace-

ment by reason of the varying sewage-flow. The wind therefore is the agent which might be easily made to ventilate sewers when it is necessary to do so.

Before leaving this part of the subject he could inform the meeting that the Main Drainage Committee of the London County Council are most anxious to throw all the light they can upon this most troublesome problem, and with that view a well-known scientist, Mr. Parry Laws, has, at the request of the Committee, made a number of experiments on the composition of sewer-air both from the chemical and biological points of view; and, although these have not been completed, it has, up to the present, not been demonstrated that pathological organisms are present in sewer-air. They certainly do not abound as persons with highly-developed powers of imagination assert; indeed, when the sewage has been caused to fall into the sewers from a height, in order to produce splashing, the germs—if present—succeeded in eluding the learned professor with a care most remarkable in so small and undeveloped an organism. Still, the author does not wish to convey the impression that he thinks sewer-air harmless.

We may next consider the working of the Main Drainage System from the sewage removal point of view, and as the system conveys both rainfall and sewage, it would at first appear to be difficult to indicate to what extent the system performs its functions as a sewerage one. The meeting will remember that in the great inquiries into London drainage that have been made by Royal and other Commissions, that a mass of information is given with regard to rainfall, and its effect in causing storm discharges. Recently, however, the Chief Engineer to the Council, Mr. Binnie, reported upon this question, and as the author assisted him in obtaining the materials for the report, he could shortly give the general results of the inquiry. Instead of looking at the question from the older points of view, it was decided to ascertain what proportion of the sewage was delivered at the outfalls and what escaped at the storm-overflows. It was not difficult to attain this object, since each storm-overflow is in charge of a man who keeps a record of the time during which it is in operation. In the result it was found that about ninety-six per cent. of the sewage is delivered at the outfall works, the remainder escaping at the storm-overflows. But in addition to the sewage conveyed to the outfalls, a very large proportion of the street washings due to rainfall are also so disposed of, to the great advantage of the river, so that on the whole the separate system, if adopted in the case of London, would not appear to be as satisfactory as the existing one. At the same time, it is only right to add that

the conditions affecting the Main Drainage System have been much improved since the works have been under the charge of the London County Council.

It is somewhat remarkable that the late Board of Works—under whose *régime* some of the finest and most enduring engineering works of the age were constructed—should have allowed the machinery at the principal pumping stations to have fallen into a state of disrepair, which resulted in a great waste of fuel and the ineffective working of the main low-level outfall sewers. This latter state was productive of serious evils on the north side, as the low-level sewer was allowed to remain always sur-charged, thus bringing the storm-overflows connected with it into operation nearly with the occurrence of every shower of rain, and also preventing the subsidiary sewers at the East End, and also at Westminster, from performing their functions properly. The late Mr. Gordon, however, when Chief Engineer, gave instructions to have the sewer pumped down, which was accomplished with some difficulty, as the pumps were worn out. New pumps have, however, been now provided at Abbey Mills, and are in course of construction at Crossness, and on the north side, as well as on the south, the low-level sewer is always kept pumped down, to the great advantage of the ratepayers, since the coal consumption at Abbey Mills is only $8\frac{1}{2}$ cwt. per million gallons pumped, to be reduced to about 6 cwt. when the engines are compounded — a contract for which has been let, as against $12\frac{1}{4}$ cwt. before the new pumps were provided, whilst from the sanitary point of view, the greatly lessened storm-discharges into the river in the midst of the metropolis is most gratifying. The meeting will remember that, acting under the advice of their Chief Engineer and Sir Benjamin Baker, the County Council are contemplating extensions of the Main Drainage System, rendered necessary by the growth of population, which will probably cost upwards of two millions sterling. A part of the suggested extensions in connection with the drainage of the East End is already in hand.

We may next briefly consider the manner in which the sewage is disposed of. As is well known, the gigantic precipitation works at Barking and at Crossness are the outcome of the inquiry of the last Royal Commission on Metropolitan Sewage Discharge, and form part of the recommendations of the Commission. As the works are alike in principle, those of the north side will only be described. The dry weather sewage flow at Barking varies from about 85 million gallons per diem to about 115 million, the mean being about 105 million. During periods of heavy rainfall the rate of flow is for a time much

increased. The outfall sewers have always been said to be capable of discharging 33,000 cubic feet per minute, their capacity being calculated by the well-known formula of Eytelwein; but recently means for gauging the effluent have been provided, and discharges of about 45,000 cubic feet per minute in rainy weather have been registered, and there is strong evidence that the sewers have, in the past, discharged even larger volumes, and the author thinks that Kutter's formula gives the true discharge within a small percentage; at any rate, the formula as simplified by Mr. Henry Law, M.Inst.C.E., may be safely used when further modified as in the following form:

$$\mathrm{V} = \frac{180\,\mathrm{R}\sqrt{\mathrm{S}}}{0{\cdot}70 + \sqrt{\mathrm{R}}} \text{ where}$$

V = velocity in feet per second.
R = hydraulic mean depth.
S = sine of slope.

The co-efficients have been slightly modified by the author, and the results appear to be quite satisfactory, as far as the northern outfall is concerned. The calculated discharging capacity of the northern outfall sewer by the formulæ mentioned is as follows:—

Eytelwein..................	34,800	c.f. m.
Kutter (modified)	46,800	,, ,,
Kutter	50,340	,, ,,

With regard to the sewage outfall works at Barking, the works as constructed by the late Metropolitan Board of Works consist of thirteen settling tanks for precipitation purposes, each tank is thirty feet wide and the length varies from 860 feet to 1,210 feet. These tanks hold collectively about twenty million gallons or about two and three-quarter hours sewage flow during the period of maximum discharge, after making allowance for those out of work for cleansing operations. There are in addition, works of an extensive and very complicated character for dealing with the sludge, consisting of settling tanks, sludge stores, and pumping machinery. There is as well the old storage reservoir, built when the outfall works were first constructed, and this now acts as an effluent water-store to some extent, so that the bulk of the effluent is discharged upon the ebb-tide.

According to the Joint Report of the Chief Engineer, Mr. Binnie, and Sir Benjamin Baker, the works at Barking, including two sludge steamers, cost £525,000, and those at Crossness about £330,000; while since the date of the report three more steamers

have been procured. But further works and extensions, not of a very expensive character, are contemplated; and when the works on both sides are complete, it will no doubt be found that they have, with the five sludge steamers, cost about one million sterling.

With regard to the general design of the Barking Works, although there are in existence very many successful examples of settling tanks which are worked upon the continuous system, those at the outfalls were designed for working on the intermittent principle. This involved effluent-water disposal arrangements of an extensive and complicated nature, and generally of an ineffective character, since it was found in practice at Barking that a very large proportion of the sludge escaped with the effluent. It was the author's duty, in conjunction with Mr. Binnie, to find a remedy, and after carefully, and indeed anxiously, considering the matter, it was decided to recommend the Council to alter the system to the continuous one, and after obtaining the approval of the Council, the necessary structural alterations were carried out at a cost of about £2,500. The sewage was forthwith treated upon the continuous principle, and the sludge produced and sent to sea from Barking immediately rose from about 8,000 tons per week to about 23,000 tons for the same period, whilst the working expenses were very materially reduced, and the effluent does not now contain more suspended matter than is found in that of other successful works of a like nature. The Crossness Works were also re-arranged, and now are worked upon the same lines as those at Barking. The chemical treatment is that recommended by Mr. Dibdin, the Council's chemist, and consists in the addition to each gallon of sewage of from four to five grains of lime in solution, and about one grain of protosulphate of iron also in solution. As before stated, clarification is very successfully performed. The total estimated cost of dealing with both the sewage and the sludge during the current financial year is about £110,000, or about 30s. per million gallons.

The sludge produced at the two outfalls during the current year will, at the present rate of production, amount to about two million tons, or say two-and-a-half million cubic yards, which would cover 500 acres to a depth of about three feet, or the whole of Victoria Park to a depth of six feet, Battersea Park to a depth of seven feet six inches, or Hyde Park to a depth of two feet, whilst if the sewage from which the sludge is obtained were placed upon the sludge in Victoria Park, it would form a mass about 1,100 feet in height. This vast mass of polluting matter will be transported to the Barrow Deep, some fifty miles below the outfalls, by means of five

sludge steamers, each of a carrying capacity of 1,000 tons, or 1,300 cubic yards, at a cost of about 3d. per cubic yard, a most gratifying result from both the sanitary and the ratepayers' point of view, for as regards the former, there is no gainsaying the fact that the river Thames is less polluted at this moment than it has been during this century. Whether finality has been reached the author will not venture to prophesy; the Thames alone can answer that question, as it will assuredly do on the conjunction of a hot summer with a small flow of upland water. Then, and then alone, will the true effect of the present operations be demonstrated.

If further treatment should be found necessary, then either land treatment, or filters so-called—which it may be remarked are not filters in the ordinary sense of the term, but rather nitrifiers, or the removal of the outfall works to a point lower down the river will probably be resorted to.

In concluding these remarks upon the treatment of the London sewage, reference must be made to the criticisms which have in the past been freely indulged in as regards the method of sewage treatment adopted. It is now proved that the treatment results in the separation of nearly all the suspended matters, and the lessening of the dissolved organic impurity by about 15 per cent., therefore it is argued by some that the treatment is insufficient. But the condition of the Thames has vastly improved, and the foreshores adjoining the outfalls are clean and inoffensive, whereas they were, before the sewage was clarified, in a most abominable condition, and it may well be asked why such an apparently slight improvement in the effluent from the chemical point of view should be productive of such excellent results. The author ventures to think that the explanation must be sought in a study of the action of micro-organisms. It is well known among biologists that ferments are mainly of two kinds, the ærobian, living in the presence of oxygen, and the anærobian which do not need oxygen in order to perform their functions.

The following experiment of John Tyndall's is a beautiful illustration of the great difference between these two classes of organisms, he says: "A drop of liquid containing those small organisms is placed upon glass, and on the top is placed a circle of exceedingly thin glass—for, to magnify them sufficiently, it is necessary that the object glass of the microscope should come very close to the organisms. Round the edge of the circular plate of glass the liquid is in contact with the air, and incessantly absorbs it, including the oxygen. Here, if the drop be charged with bacteria, we have a zone of very lively ones; but through this living zone, greedy of oxygen and appropriating it,

the vivifying gas cannot penetrate to the centre of the film. In the middle, therefore, the bacteria die, while their peripheral colleagues continue active. If a bubble of air chance to be enclosed in the film, round it the bacteria will pirouette and wabble until its oxygen has been absorbed, after which all their motions cease. Precisely the reverse of all this occurs with the vibrios of butyric acid. In their case it is the peripheral organisms that are first killed, the central ones remaining vigorous while ringed by a zone of dead. Pasteur, moreover, filled two vessels with a liquid containing these vibrios; through one vessel he led air, and killed its vibrios in half an hour; through the other he led carbonic acid, and after three hours found the vibrios fully active. It was while observing these differences of deportment fifteen years ago that the thought of life without air, and its bearing upon the theory of fermentation, flashed upon the mind of this admirable investigator."*

The bearing of this experiment upon the pollution of rivers is obvious. If the suspended matters in sewage are not removed, they are deposited in the bed of the river, where the oxygen, dissolved in the river-water, is merely brought into contact with its surface and cannot penetrate its mass; hence the organic matters in the mud or sludge are broken up by putrefactive ferments, which produce sulphuretted hydrogen and other evil-smelling compounds, whilst on the other hand, if the sewage is clarified before being discharged into a river the dissolved organic impurities in the effluent are disseminated in the river-water, which, if sufficient oxygen be present, teems with ferments which break up the organic matters into inoffensive minerals and gases. The author ventures to give this explanation in connection with the fact that the Thames is in a vastly better condition than would appear to be possible if the question were discussed purely from the chemist's point of view. If further confirmation of the views advanced by the author were needed, it may be found in the Report by the State Board of Health of Massachusetts, 1890, where, at page 553, the results of observations on the water of lakes and ponds at different depths are given, and it is clearly demonstrated that when mud at the bottom of deep lakes contains organic impurities, the lower layer of water becomes very foul. "Water drawn from near the bottom of such lakes contains, besides much ammonia, usually a large amount of offensive gases such as sulphuretted and carburetted hydrogen, while dissolved oxygen is completely absent. In foul water of this character the varieties of animal and vegetable life which

* "The Floating Matter of the Air," John Tyndall, 1883.

we find in the water nearer the surface are almost, if not entirely, absent, and bacteria are abundant."

In conclusion, the author would like to remark that in his opinion the solution of the huge problem of London sewage disposal will be accomplished by land treatment, or with the aid of those minute organisms which nature has provided in countless numbers, in order to perform her work in her own, as yet perhaps, mysterious manner. Organic matter must be broken up and rendered harmless, nature provides the means if man will employ them intelligently and aid her in her work; and although we stand as it were but upon the threshold of this new science, it will be conceded that already our views upon the subject have been broadened, and we have been enabled to break away from many of the traditions handed down to us by some of the pioneers of sanitary science.

Sir Robert Rawlinson, K.C.B. (Chairman), said he would confine himself at the moment to proposing a hearty vote of thanks to Mr. Santo Crimp for his most instructive paper. The vote was thereupon responded to enthusiastically.

Mr. Henry Law, M.Inst.C.E. (London), said he had been acquainted with the subject of the metropolitan sewage for many years. He called attention to the enquiry held some time since, by order of the Home Secretary, before Sir Charles Hartley, Sir Frederick Bramwell, and Sir Douglas Galton, as to the alleged creation of shoals in the Thames at Woolwich, Barking, and Crossness, in consequence of the discharge of the metropolitan sewage at Barking and Crossness; the result of that enquiry, as expressed in the award of the Arbitrators, proved that the shoals in question were caused by the dredging operations which had been carried out by the Thames Conservators for the improvement of the navigation. At the later enquiry which took place before the Commission on Metropolitan Sewage Discharge, of which Lord Bramwell was Chairman, although much evidence was given as to the polluted state of the river, it was shown that the riverside population was more healthy than those people who lived further away from the river. His own view was that there was no such pollution as to warrant the expense of carrying the sewage down to the sea. He thought the present method best and most economical. The argument that the existing system of throwing the sludge into the sea was a waste of valuable material, reminded him of the case of the copper slag at Swansea, which, containing a large per centage of iron, an attempt was made some years since to reduce the iron, but the expense of doing so was found to be greater than obtaining the metal in the usual way from the ore. No doubt sewage sludge

contained fertilizing properties, but in most cases it cost more than it was worth to make use of it.

Sir Robert Rawlinson reminded the meeting that he had held an enquiry, the result of which showed that the banks of the Thames were much mudded up by the discharge of the settling tanks.

Lieut.-Col. Jones (Carshalton) referred to two papers similar to Mr. Santo Crimp's, which had been read at the Institution of Civil Engineers. He contrasted the two and found one practical and the other theoretical. He did not think the Thames was by any means pure, and he agreed with the Medical Officer of Health for the Port of London in the opinion expressed in his report of October last. He attributed the recent improvement greatly to the more general use of destructors and to the pumping mills. He thought the statement that the transport of sludge cost 4d. per ton was rather startling. He would have liked to have had more information regarding the overflow.

Major Lamorock Flower (London) referred to the abuse of storm overflows into the Thames and Lee. On one occasion he had seen the storm outlet into the Lee at Old Ford turn the head of a barge, and he had known the water raised as much as six inches by the outflow of sewage during a storm. He thought the outlet might be carried elsewhere, or the sewage treated chemically. The London County Council had looked into this matter but had never done anything, although he had been informed that for eight days last year the sewage had been treated chemically, but the river was worse instead of better after the treatment. There was at the present time an epidemic of small-pox raging, which he attributed entirely to the conditions produced by abuse of the storm-outlet. He considered it a great pity that the pumping machinery at Abbey Mills had been allowed to get out of order. The whole subject required time for experiment, but he did not think the best way of overcoming the difficulty was to take the sludge out to sea; if at another place which he might name they took their sludge out to sea, they would wish they had never been born.

Mr. R. W. Peregrine Birch, M.Inst.C.E. (London), said he was pleased to hear that there was an improvement in the state of the river. He had assisted the Corporation in proving the bad state of the river, in consequence of which the new works had been erected. With regard to Mr. Crimp's belief that a hot summer and a small flow of upland water would demonstrate the efficiency or otherwise of the present system of sewage disposal, he had had occasion to ascertain the fact that if the sewage were taken twenty miles farther down, it would do more good in the way of dilution than if the flow over Teddington Weir were increased six or seven times. Referring to the chemical treatment of sewage, he said chemists should study

what was the particular condition of sewage that made it yield to chemical treatment. It was clearly shown, by the experiments made by Mr. Dibdin, that there was more difference between the effect of the same treatment on two different samples of sewage, than there was between the effects of the mildest and the strongest treatments of any given sample.

Dr. G. V. Poore (London) said he thought they were coming to some solution of the matter now that people were beginning to see that the purification of the river was a biological and not an engineering question. Referring to the state of the Thames, he said that at the time of the building of the new London Bridge the old water-works were in existence, and up to the beginning of the century the Thames was pure enough at London Bridge for the water to be distributed to the inhabitants. He had no doubt that the impurity of the Thames was due to the great increase in population and to the fatal invention of water-closets. It was very important that villages should not be allowed to copy London. He said that the nitrogenous matter in the sewers was worthless, as nobody knew what town sewage was composed of, and it could not be depended upon. One of the first things to be done was to make large manufacturers dispose of their own waste products. He had no doubt that excremental matters were of great use if taken in their dry state, and if this could be done it would greatly assist the crops and give work to the unemployed.

Mr. A. F. Andresen (Hampstead) advocated the system of drainage devised by Dr. A. Carpenter as opposed to the present London system. He thought the proper way was to give the sewage to the land, and said it should be distributed in different directions over the country. Personally he thought the state of things at Barking was intolerable, and thought that the example of Berlin should be taken, and Dr. Carpenter's system looked into.

Mr. Rogers Field, M.Inst.C.E. (London), welcomed the fact that the County Council and the District Boards of Works were changing the present defective sewers into self-cleansing ones, which he regarded as a great reform. There were undoubtedly a large number of bad sewers in London. There was one point in the paper he thought rather misleading: it was the statement that the present precipitation works were the outcome of the inquiry of the Royal Commission. This might be taken to mean that in carrying out these works the County Council were carrying out the recommendations of the Commission, whereas this was not quite true. The Commission recommended this step as a preliminary means only, and went on to say that the liquid was not sufficiently free to be permanently discharged into the river, and should be further treated and sent on the land. They considered there was sufficient land for the purpose north of the river, but not on the south, so that the liquid must either be carried over to the north or else out to sea. The Commission distinctly said that it was only a preliminary means,

and that as a permanent measure it must be taken to the land. He thought Mr. Santo Crimp could not have meant to convey this rather misleading impression, as his subsequent remarks led one to believe that he regarded land treatment as the ultimate means of the solution of the problem. With reference to Mr. Crimp's observations about microbes, he thought that glaring pollution no doubt came more from sedimentary matter than from that in solution, but all the best authorities, both in England and abroad, agreed that chemical treatment could not be compared with land treatment as regards the removal of matters in solution. The circumstances mentioned by Mr. Crimp, as to the low level sewer on the north side always remaining surcharged on account of the pumping machinery having fallen into disrepair, was a remarkable one, and had no doubt tended to cause the storm-overflows frequently to come into action.

Mr. G. Weston (Surveyor to the Vestry of Paddington) stated that he quite endorsed what Mr. Santo Crimp said with respect to the necessity of parishes systematically repairing the inverts of old sewers and improving their gradients. Some sewers in Paddington had been down for many years, consequently their inverts in places were sunk which caused elongated cesspools to be formed, and the sewage was unable to freely flow away, and when this occurred near ventilating shafts, caused unpleasant smells to be experienced in the streets, especially during hot and dry weather. He was instructed to examine the sewers, and report to his Vestry in March, 1890, on this matter, and since that date they had been repairing and improving the defective sewers in the parish with beneficial results at an expenditure of £5,000 per annum, and this was to continue annually until the sewers needing repair were completed.

Mr. Rhodes (Past Chairman of Main Drainage Committee, L.C.C.) believed that the treatment and disposal of sewage must depend on the conditions under which it is produced. He referred to Mr. Baldwin Latham's differentiated treatment. Mr. Latham had carried out the agricultural treatment, and was regarded as its apostle; but in places where that system was inapplicable he got rid of it in the cheapest way. He instanced Margate, where the sewage was carried into the sea, this system having been designed by Mr. Latham. Referring to London sewage, he said that on the advent of the County Council, he was elected Chairman of its first Main Drainage Committee, and with the assistance of the committee had had to deal with the problem in different stages. They had to take up the works at Crossness and Barking in a very imperfect state, and deemed it advisable in improving Barking to stay their hands at Crossness, in order to see the result of the experiment at the former works, for it was unlikely they would prove to be designed (from want of working experience) on the best lines. They found out, *inter alia*, that the *intermittent* system of dealing with the sewage was a mistake and led to much expense and trouble; and the result of the experiment at Barking was that the *continuous* system was substituted and

had proved a marked success. With regard to the condition of the river, he said that in the time of the Metropolitan Board of Works raw sewage was always being emitted, and, in consequence, made the river one huge precipitation tank. Therefore, although the sludge was now withdrawn, this evil work would require considerable time to be made good. The condition of the river was for a time made worse by the alterations, but now one had only to go and see, to be assured of the immense improvement in the river. Everyone was of opinion that the success of the present system had been proved. He thought that the Royal Commission's recommendation of the existing system as a "*temporary measure*" did not prove that it might not succeed as a permanent one. He asked whether anyone could reasonably doubt that the improvement on the north, would be followed on the south, and he thought that the system would bear us out for years to come. Yet he believed in progress, and would not say that he might not in future be induced to review his opinion, although at present he thought we had a system on which we could depend.

Mr. Lewis Angell (Borough Engineer, West Ham) referred to the advisibility of the sewage arrangements of greater London, the most populous part of which he represented, being taken over by the London County Council. With regard to the sewage overflows in the Lee, he could not see that the inactivity of the pumping machinery at Abbey Mills had any bearing on the question, as they only served to raise the sewage from the low level, and had no connection with the high level overflows.

Sir Robert Rawlinson (Chairman) said that there could be no greater question for Londoners than that of sewage disposal. There was no doubt that the lower reaches of the Thames were polluted, and that in times of rain the upper reaches were also much polluted by the outfalls. A great deal had been said about the origin and construction of the London sewers and their defects; but it must be borne in mind that the population had greatly increased from that time, and that engineers had had nothing to guide them by way of experiments in providing for rainfall from so large an area. Standing at the beginning of the Sanitary movement, he had had to learn everything for himself, and had found that to provide adequately for rain, one would have to make the sewers very much larger than was necessary to carry away the excreta. He believed that Mr. Hugh Mackay, under his direction as Chief Engineer, had carried out the first system of self-cleansing sewers in Carlisle, where all sewage was removed from the city within twelve hours. To have done this for London would have been a miracle, as there were no experiments on smaller scales to serve as guides. He said the Fleet Ditch ought never to have been covered and made a sewer, as it drained an area of about 4,000 acres, and in dealing with a corresponding area, he had found the flow vary from 300,000 to 90,000,000 gallons a day. This would explain the enormous volume of water

that had to be provided for in the Fleet Ditch, in addition to the sewage let into it on both sides. This was a question which was considered now, but was not thought of years ago. Regarding the difficulties of dealing with rainfall he instanced India, where twelve inches of rain had been known to fall in twenty-four hours, and pointed to the enormous volumes which at times fell in Australia. How could such great volumes of water be dealt with in sewers? With regard to India, he would prefer to confine himself to dealing with the waste water from houses. Turning to the question of sewage, he said it contained all the ingredients from a large population, and was undoubtedly rich in manurial character. All chemicals that were used, in his opinion, polluted the sewage, and clarified sewage became stinking in spite of the clarification. Mr. Crimp had indicated that the sewage must eventually go to the land, and therefore he thought it a great pity so much money was to be wasted on the costly barges now in construction. He said that at the mouth of the Thames there was a splendid area of sand over which, if turned by conduits, the sewage might be allowed to run. Contracts might be made with farmers to take sewage for irrigation purposes, and he thought that if it could be obtained, farmers would pay a good price for it. In his opinion statesmen had made a great mistake when they took the dues off coal and wine, as coal had not been made any cheaper, and poor people had not consumed wine, and the dues might now have paid for the necessary outfall sewage works.

Mr. Santo Crimp (London County Council) said, in reply to the discussion, that his task was a light one, because Mr. Rhodes had answered many of the questions. With regard to the storm-overflows at Old Ford, these were placed upon a navigable canal, with a very slight current, and the effect was to convert the canal into a settling tank when the overflows were in operation. The arrangement was therefore not a good one. Of course the pumping down at Abbey Mills only affected the storm-overflows on the low level system, and not those at Old Ford. With regard to Col. Jones's remarks, they had experienced some trouble in pumping sludge through mains, some 900 feet in length, and he thought it would be rather risky to attempt to pump it as far as Canvey. One speaker had referred to the Berlin farms, no doubt these were interesting, but so far from sewage farming being played out in this country, we had at Birmingham the sewage of 600,000 persons applied to the land; at Nottingham, 213,000; at Leicester, 180,000; and nearer home, about 80,000 at Beddington, and 30,000 at Wimbledon, and sewage farms in this country were constantly being extended. With regard to London, the question was a very large one, but they had in Essex land that was unmanured and uncultivated, they had sewage that was unutilized, they had labour that was unemployed, and if the liquid and the labour could be employed upon the land without placing a burden upon the shoulders of the ratepayers, he thought it was a consummation devoutly to be wished.

LECTURES ON THE SANITATION OF INDUSTRIES AND OCCUPATIONS.

OCCUPATION AND MORTALITY.

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Read November 2nd, 1893.

The lecture which I have the honour to give is introductory to a course of six lectures, to be given by various specialists, which, although they cannot, of course, cover the whole range of the sanitation of industries and occupations, will, it is hoped, give a practical insight into some of the more important problems connected with this subject.

The importance of the subject.—A moment's reflection will show the enormous influence of a man's occupation on his health. At least one-third of each working day is spent under the conditions implied in this occupation, and it may therefore be credited with this proportion of the total influence exerted by the circumstances of life on health. The influence exerted by occupation is however much greater than this. Conditions of overcrowding are more deleterious during active work than when lying quietly in bed. Overcrowding implies an atmosphere loaded with the products of respiration, which are when re-breathed a fertile source of disease. Dr. E. Smith found that if the air inspired lying down be represented by unity, the amount inspired when standing erect is 1·33; when on a treadmill, lifting 196 lbs. through 1920 ft. per hour, 4·40; and when walking four miles an hour, 5. Not only is more air inspired during active work, but there is a corresponding increase in the amount of carbonic acid eliminated by the lungs. Thus during rest 13·11 grains of CO_2 are expired per minute; on a treadmill, under the conditions named above, 57·68 grains per minute. If, as in ill-ventilated warehouses and shops, the carbonic acid resulting from respiration is not quickly got rid of, the substance of the muscles becomes loaded with carbonic acid and their activity diminished. For this reason, if for no other, it would be economical for large employers of labour to provide an abundant supply of fresh air for their workpeople.

Conditions of overcrowding in insanitary factories and workshops are aided by the effects of inhalation of dust and

irritating or offensive effluvia, or the absorption into the system of chemical poisons, or the effects of undue strain or over-exertion. These various considerations give to the industrial side of hygiene an importance which is secondary to no other.

Past Neglect of Industrial Hygiene.—Notwithstanding its importance it cannot be said that Industrial Hygiene is one of those "flat and flexible topics which have been beaten on by every hammer." There are scattered papers in the medical journals, and in the reports of factory inspectors, and a few papers contributed to the Royal Statistical and other societies, and three or four books, of which the most recent and at the same time the most accurate and exhaustive is Dr. Arlidge's *Diseases of Occupations.* These represent the whole literature of the subject in English. French and German hygienists have expended much more labour on the subject; they have published elaborate statistics which are very generally defective or fallacious in one particular or another; and under the different conditions holding good in this country but little use can be made of the data they have collected.

Legislation on Industrial Hygiene.—In saying that industrial hygiene has been much neglected in the past, the importance and value of factory and workshop legislation is not ignored.

A legislature, which, urged on by the pressure of public opinion, has passed the Factory and Workshop Acts, culminating with that of 1891, and has devised and arranged so many checks and curbs on unscrupulous masters and careless workmen; which has altogether prohibited the employment of women in certain industries, and curtailed their hours in others; which has raised the minimum age of employment of children in factories and workshops to eleven years, and insists on a previous medical examination of all children thus employed; which has by the Shop Hours' Act of 1891 prohibited the employment of young persons under eighteen in shops for a longer period than seventy-four hours, including meal times, in any one week; and which has by the Alkali Works Regulation Acts, the Coal and Metalliferous Mines' Regulation Acts, the Merchant Shipping Acts, the Canal Boats' Acts, &c., regulated other industries in a more or less efficient manner, cannot be said to have adopted the policy of national selfishness, which is embodied in the theory of *laissez-faire.* The majority of these enactments are still administered by Government Inspectors. These inspectors have in the past done work of great importance to the health of the community. The principle is however being gradually accepted that this work should be delegated as far as possible to Local Authorities. In the case of bake-houses this has been already done with good results, and gradual extension of such

decentralisation is desirable. If this work is placed more fully in the hands of Local Authorities, the appointment of inspectors should be made compulsory on these Authorities, and districts should be so combined as to ensure the appointment of skilled inspectors, with reasonable fixity of tenure of an office, which like other sanitary work implies interference in the interest of workers with wealthy proprietors.

What is rather meant, when I state that industrial hygiene has been neglected in the past, is that the opportunities afforded for investigating and elucidating the influence of various industries on the health of the workers in them, have not been fully utilised; and as sound progress in the prevention of industrial diseases must rest on medical and hygienic study of these diseases, valuable time has been to that extent lost.

Much of this neglect of investigation into industrial diseases is owing to the difficulties inherent to such an enquiry. The pathological material connected with our large hospitals has been utilised to a certain extent. The medical enquirer has, however, in investigating the relative prevalence of any disease in a given occupation, been beset by overwhelming difficulties.

Statistics of Occupations.—Correct statistics of any occupation can only be obtained when the deaths in that occupation are stated in proportion to the total number of persons engaged in it. An initial requirement is therefore an accurate statement of the number engaged in each occupation.

Difficulties in Classifying Occupations.—Classification is by no means an easy task. The number of distinct industries in this country is enormous. Most of these industries are sub-divided with great minuteness, thus further complicating the task. Twenty-four orders of occupation are described by the Registrar-General, which comprise eighty sub-orders or genera. The orders are grouped into six classes; viz., professional, domestic, commercial, agricultural, industrial, and non-productive. The lines of demarcation between these classes must not be supposed to be very definite, though the classification is convenient.

The number engaged in each of these six classes at the census of 1891 was as follows:—

	Persons.	Males.	Females
Total aged 10 yrs. & upwards..	22,053,857	10,591,967	11,461,890
Professional Class	926,132	597,739	328,393
Domestic Class	1,900,328	140,773	1,759,555
Commercial Class	1,399,735	1,364,377	35,358
Agricultural & Fishing Class ..	1,336,945	1,284,919	52,026
Industrial Class	7,336,344	5,495,446	1,840,898
Unoccupied Class	9,154,373	1,708,713	7,445,660

Whatever classification of occupations is adopted errors must occur, largely owing to *ambiguity in the nomenclature of occupations.*

A drummer may mean either a musician or a blacksmith's hammerman; an engineer may be either a maker or a driver of engines; a collar-maker may be a seamstress or a harness-maker. In these instances the confusion is only between two occupations. But the same name may apply to a larger number of different trades. Cotton, silk, wool, and flax factories alike have spinners, weavers, &c., and unless some further specification is added to these occupations, confusion must arise. Similarly, merchants, miners, mechanics, artisans, and labourers, are frequently returned as such without further definition, thus rendering their classification under special headings impracticable.

One great source of difficulty is the occurrence in the same individual of *double occupations.* The same person may be a farmer and a miller, a plumber and a gas-fitter, or a clergyman and a schoolmaster. The general rules adopted in the census * are that a constructive or mechanical handicraft is invariably preferred to a mere shop-keeping occupation; and that of two occupations, the apparently more important one is to be selected; or failing any special indication, the occupation first named on the census return is to be taken.

Another great source of difficulty is in *the separation of classes.* It is often very difficult to separate between masters and men in any given trade or manufacture. A watchmaker or tailor may be either a master or journeyman, the health conditions in the latter case being probably much more unfavourable than in the former; and similarly in other cases.

The difficulties in classifying the occupation returns of the census, which have been briefly indicated, apply even more forcibly to death returns. It is evident, therefore, that it is only in certain clearly recognised and well-defined groups of occupations that accurate occupational death-rates can be deduced. We must be satisfied, to quote the golden rule laid down by Joshua Milne, that "the population enumerated is precisely that which produces the deaths registered," the great desideratum being "to determine the number of annual deaths at each age which takes place among the living at the same age." These rules have been so frequently neglected, that a large share of the occupational statistics which have been published are untrustworthy.

Erroneous Forms of Occupational Statistics.—(1) Much of

* General Report of 1881 census of England and Wales, Vol. IV. pp. 27 & 28.

the earlier work on occupational statistics is invalidated by the acceptance of the *mean age at death* of men employed in different industries as a trustworthy indication of the relative salubrity of these industries. This is evidently fallacious. The mean age at death is governed by the mean age of the living, and it is as much affected by the ages at which people enter and leave any given occupation, and by the increase or decrease of employment, as by its salubrity or insalubrity. Mr. Ben Tillett in 1890 stated that the average age at death of workmen was 29—30 years, of the well-to-do classes 55—60 years. It is probably quite true that the prospects of life of the average workmen are less favourable than those of the average member of the well-to-do classes; but Mr. Tillett's statement, founded as it probably is on the experience of Trades' Union Societies composed largely of young men, by no means proves this.

In 1888 the Collective Investigation Committee of the British Medical Association reported, as the result of an elaborate inquiry, that of

122	Total Abstainers the average age at death was			51·22 years.
1529	Habitually Temperate	,,	,,	62·13 ,,
977	Careless Drinkers	,,	,,	59·67 ,,
547	Free Drinkers	,,	,,	57·59 ,,
603	Habitually Intemperate	,,	,,	52·03 ,,

This was seized upon by the brewing interest as proving that the prospects of life are diminished by total abstinence, while there was a corresponding fluttering and agitation in the temperance dovecotes. It is obvious that no valid comparison is made in the preceding statement between the two groups. The statement of age of the dying, the age of the living being ignored, can only mislead, as it did in this instance. It would be absurd, similarly, to draw any inferences from a comparison of the mean ages at death of bishops and curates, as men do not usually become bishops till they have passed the middle period of life. The low mean age at death of dressmakers has been adduced as a proof of the unhealthy character of their employment. Without denying the latter fact, the low mean age at death of dressmakers is no more a proof of their insanitary circumstances than is a low mean age at death among the pupils in a boarding school.

Mr. F. S. Neison, in a paper contributed to the Statistical Society in January, 1844, showed very clearly the errors following on the use of this method by comparing the populations of the districts of Bethnal Green and St. George's, Hanover Square. He found that

The number living—	Bethnal Green.	St. George's, Hanover Square.
Aged 23—25, was..	8·9 °/₀ of total.	14·2 °/₀ of total population.
,, 5 and under..	14·5 ,,	8·6 ,,

and he showed that were the population of Bethnal Green to be transferred to St. George's, Hanover Square, and submitted to the conditions of mortality of the latter, the mean age at death at St. George's, Hanover Square, would be reduced from 31·23 to 27·25 years (the mean age at death at Bethnal Green being 25·80 years). It is evident, therefore, that the population of St. George's, Hanover Square, at that time, instead of having on an average 5·42 more years of life, had only 1·45 years more than Bethnal Green.

(2). The proportion between the number engaged in and the number dying in any given occupation, expressed as a rate per 1,000, is also fallacious. As is well known, the death-rate in the general population varies greatly at different groups of ages. The death-rate among those engaged in any one occupation would similarly vary according to the relative number at the different ages engaged in it. In other words, it would depend on the *ages of the living*, which would vary in every occupation, (*a*) according as persons enter it early or late in life, and (*b*) according as the numbers that annually enter it increase or decrease. Dr. Farr, in his 14th Report, gives the following example of the mistakes which would follow the adoption of this method. The death-rate of all farmers over 20 years of age were 28 per 1,000, of all tailors 20 per 1,000; but when tested by a comparison of the death-rate among men of corresponding ages, farmers were much healthier than tailors, as seen in the following table:—

Death-rate per 1000 *at Six Age-groups of Farmers and Tailors.*

Age.	25	35	45	55	65	75
Farmers . .	10·15	8·64	11·09	24·90	55·30	148·62
Tailors . .	11·63	14·15	16·74	28·18	76·47	155·28

The only trustworthy method is to compare the mortality of those engaged in one occupation, and of a given age, with the mortality of those engaged in another occupation and *of a corresponding age.*

This is the method adopted by Dr. Ogle in his report for the decennium 1871—80, and it is his figures which will be chiefly quoted. The report of the decennium 1881—90 has not yet been issued, so that any figures which are given are necessarily to a certain extent out of date.

Sources of Possible Error.—Even supposing that occupational statistics are constructed by the correct method just indicated,

some sources of possible error still attach to them. These are pointed out by Dr. Ogle, who however rightly claims for his results a high degree of trustworthiness, on account of the width of his basis of operations, and the precautions taken to ensure uniformity in the abstraction of the figures on which the statistics are based.

These sources of error exist even when the difficulties connected with the classification of occupations have been overcome, and the fallacies connected with the paucity of data have been avoided.

Paucity of data often forms a difficulty in local occupational statistics, as the number engaged in any given industry is necessarily limited, and the observations of several years must therefore be collected, in order to remove variations due to accidental causes. The scantiness of material seldom however reaches the level of that of the parliamentary questioner who asked Mr. Stanhope if it was his intention to retain a British garrison at a post in Africa where the mortality had been 800 per 1000. The reply admitted this high death-rate, but explained that the garrison in question consisted of a corporal and four men, of whom one was accidentally shot when on a shooting expedition, one was eaten by a crocodile while bathing, a third died of sunstroke, and the fourth died as the result of lying out all night in a drunken fit!

For one difficulty pointed out by Dr. Ogle there appears to be no remedy, and it must always to some extent diminish the value of all calculations of the death-rate in different industries. Many trades, as that of a blacksmith or miner, require great muscular strength, and must be given up by men when they become weakly; and the latter may then raise the mortality of the lighter occupations to which they resort.

Another flaw in occupation death-rates, when taken as tests of the relative healthiness of different industries, is the fact that those who follow these do not start on equal terms as regards healthiness. A weakling will not become a navvy, but a shopman or tailor by preference. The occupations demanding great muscular strength and activity, to some extent then, consist of picked men, stronger at the commencement, and maintained up to a certain standard by the fact that weaklings are drafted into lighter occupations.

After making full allowance for the preceding difficulties, the death-rates of different occupations still furnish most valuable indications of their relative salubrity; and while small differences may be accidental, large differences must be taken as representing real differences of healthiness in the various occupations.

When we pass from a comparison of death-rates from all causes at different age-groups, to a comparison of death-rates from special forms of disease at the same age-groups, the subdivision is greater, and the danger of errors arising from scantiness of material is increased. There are, however, certain diseases concerning which there is abundant evidence of their special association with particular industries, and these will be further discussed shortly.

Outdoor and Indoor Occupations.—From a hygienic standpoint, a vitally important classification of occupations is into (*a*) out-door, and (*b*) in-door.

The following table, re-arranged from one given by Dr. Ogle,* brings out this point. It should be explained that the figures relate only to males between 25 and 65 years of age, the death-rates of men between 25 and 45, and between 45 and 65 having been in each case applied to a male population in which those under and those over 45 bear a fixed proportion to each other. The clerical profession, having the lowest death-rate, is taken as the standard and stated as 100; the death-rate of each of the other occupations being stated by a figure proportionate to this standard.

Comparative Mortality of Men aged 25 *to* 65 *years*, 1881-2-3.

OUTDOOR OCCUPATIONS.			
Gardeners	108	Fishermen	143
Farmers	124	Masons and Bricklayers	174
Agricultural Labourers	126		
MIXED OCCUPATIONS.			
Clergymen	100	Medical men	202
Lawyers	152	Carpenters	148
INDOOR OCCUPATIONS.			
Commercial Clerks	179	Tailors	189
Bakers	172	Shoemakers	166
Shopkeepers	158	Bookbinders	210

It is evident that in industrial occupations, the balance is very greatly in favour of outdoor work. With the exception of the clerical profession, those engaged in agriculture have the highest probability of life. Even fishermen, notwithstanding their exceptional proneness to fatal accidents, compare very favourably with those engaged in indoor occupations. In occupations where the evils connected with the inhalation of dust arise, the mitigating effect of work in the open air is felt.

* Transactions International Congress of Hygiene and Demography, Vol. X., p. 14.

Masons and quarrymen who work in the open air have a mortality from lung diseases, which is only from two to three times that of fishermen; while that of Cornish miners and potters, who work in more confined space, was in 1880—82 five to six times that of fishermen (Ogle).

Rural and Urban Industries.—The conditions of urban life involve a larger proportion of indoor occupations than those of rural life. The increased urban population in this country has been the result of an immense increase in manufacturing and mining industries. At the census of 1861, 37·7 per cent. of the total population of England and Wales was rural; at the census of 1881, this proportion had decreased to 33·4 per cent.; and at the census of 1891, to 28·3 per cent. Now the average urban death-rate was 24·8, and the rural death-rate 19·9 per 1000 in the decade 1861—70; 23·1 and 19·0 in 1871—80; and had become 20·3 and 17·3 respectively in 1881—90.* It is evident therefore that rural (*i.e.*, in a large measure outdoor) conditions of life are much more conducive to health than urban conditions. The real difference is greater than is shown by these uncorrected death-rates; for the age-distribution of urban is more favourable to a low death-rate than that of rural districts. Thus, as Dr. Ogle shows, if the annual death-rate in England and Wales at each age-period be applied to the respective urban and rural populations at the census 1881, the death-rate in the urban population would be 20·40 (instead of 23·1); in the rural population, 22·83 per 1000 (instead of 19·0). That is, assuming that the urban and rural populations were equally healthy, the death-rate of the former should have been 4·09 per cent. below, and that of the latter 7·33 per cent. above the mortality of England and Wales as a whole.

It will be noticed that urban death-rates show a greater decline than the rural. This cannot be explained completely by the increased afflux of young and healthy recruits from rural districts; it is an indication that in towns sanitary administration is more active, and the health conditions of life are improving more rapidly than in country districts.

It would be interesting to inquire how far the diseases of workmen with which we are concerned *are town made, and how far they are trade made.* The aggregation of workmen in towns implies a less pure atmosphere, a diminished freedom of access of this atmosphere to their homes and workshops; high rentals, with their concomitant evils of sub-letting and overcrowding of

* Stating the deaths in town districts to 100 deaths in country districts, out of equal numbers living, there died in towns in 1851—60, 124; in 1861—70, 126; in 1871—80, 122; in 1881—90, 117; and in 1891, 114.

tenements; an absence of gardens and cheap home-grown vegetables; a deficient supply of milk, too often "separated," for their children; and many other evils, which a comparison between country and town life renders obvious. Could our great industries be more widely scattered in small communities, there is no reason to doubt that occupational mortality would decline with increased rapidity. It is well known that miners living some distance from their work suffer less than those living near at hand; and we may reasonably hope that with cheap workmen's trains, enabling workmen to live beyond the outer circle of our towns, great improvement will be seen.

Consumption and Occupation.—Stress has been laid on the distinction between indoor and outdoor, urban and rural occupations. This is essential, inasmuch as impure air is one of the chief causes of disease. The langour, headache, and drowsiness which result from a temporary exposure to a vitiated atmosphere, are followed if the exposure is more chronic by a general lowering of bodily and mental vigour. The tendency to catarrhs is increased, and apart altogether from the provocative action of dust, "colds" and bronchitis are more common than among those living an outdoor life.

Phthisis, or consumption, is the most fatal disease of adult life. In the five years 1886—90, phthisis caused 8·7 per cent. of the total deaths in England and Wales. In the thirty-five most active years of life, from 20 to 55 years of age, phthisis caused 20·6 per cent. of the total deaths of males during the year 1891. In the same year, bronchitis only caused 5·6 and pneumonia 11·7 per cent. of the deaths from all causes at ages 20—55.

The close association between phthisis and indoor occupation has been long known. Dr. Greenhow, in most important reports to the General Board of Health and Privy Council in 1859—62, showed most conclusively from an analysis of the statistics of lung diseases in agricultural and manufacturing populations respectively, that "in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion *ceteris paribus*, their respective death-rates from phthisis are increased." In indoor occupations involving much muscular effort, the amount of phthisis is less than in those of a more sedentary character. An examination of the history of 6,000 patients admitted to the Brompton Consumption Hospital showed that two-thirds had indoor occupations, the occupations of milliners, sempstresses, and tailors being specially predominent.

From the records of Millbank Penitentiary during the eighteen years 1825—42, Dr. Baly showed that the mortality

from tubercular disease was three or four times as great as it was in the year 1842 among persons of the same period of life in London generally. A sentence of imprisonment for fifteen years was then equivalent to a sentence of death by phthisis. If time allowed, even more striking instances of the evil effects of indoor occupations, under conditions of overcrowding and deficient ventilation in favouring the development of phthisis, might be given.

With advancing knowledge, heredity as a cause of phthisis has been pushed into the back ground. It is now known that the essential cause is the introduction into the system of the tubercle bacillus. Vitiated air, defective food, fatigue, inherited weakness, act as predisposing causes, by lowering the general health and originating catarrhal inflammations, and thus diminishing the resistance of the organisms to the infection, which is always introduced *ab extra*.

The infective material is inhaled in the majority of cases as dust, which contains the desiccated expectoration of phthisical patients. To diminish this danger, every workshop and factory should have a spittoon provided in each room containing some disinfecting fluid, and the dirty habit of spitting on the floor should be prohibited. By steady and gradual education of workpeople the centres of infection may thus be diminished, and the danger of predisposed persons acquiring phthisis minimised.

The following table given by Dr. Ogle* shows the influence of vitiated air in the production of phthisis and other lung diseases. Fishermen are taken as a standard, their mortality from these diseases being represented as 100.

Comparative Mortality of Males aged 25 to 65.

	Occupation.	Phthisis.	Other Lung Diseases.	The two together
Pure Air	Fishermen	55	45	100
	Farmers	52	50	102
	Gardeners	61	56	117
	Agricultural Labourers	62	79	141
Confined Air ..	Grocers	84	59	143
	Drapers	152	65	217
Highly Vitiated Air	Tailors	144	94	238
	Printers	233	84	317

* Op. cit., p. 17.

The essential cause of phthisis is the inhalation of dust containing the specific bacillus of this disease. Hence persons engaged in dusty occupations are much more prone to be affected than others who are simply exposed to a vitiated air. To quote Dr. Ogle again:*

Comparative Mortality of Males aged 25 *to* 65.

	Phthisis.	Other Lung Diseases.	The two together.
Fishermen (as standard)	55	45	100
Coal Miners	64	102	166
Carpenters and Joiners	103	67	170
Bakers	107	94	201
Masons and Bricklayers	127	102	229
Wool-workers	130	104	234
Cotton-workers	137	137	274
Stone and Slate Quarrymen ..	156	138	294
Cutlers and Scissor Makers ..	187	196	383
File Makers	219	177	396
Pottery Makers	239	326	565
Cornish Miners	348	231	579

The dust inhaled by carpenters and bakers appears to be comparatively innocuous. The dust from woollen fabrics, and still more from cotton, is much more prejudicial; while mineral dust, as shown in the later occupations given in the table, is highly injurious.

The metallic dust in file-making and cutlery causes a mortality from chest affections which is nearly four times that prevalent among fishermen, who are not exposed to dust. The death-rate from these diseases alone is almost equal to the total mortality from all causes (including accident) among fishermen.

The dust of stone is even more formidable than metallic dust. Masons and quarrymen work in the open air, so their mortality from phthisis is only two or three times as great as that of fishermen. Potters and Cornish miners work in more confined space, and their mortality from these diseases was, at the period to which Dr. Ogle's returns apply, five to six times as high as that of fishermen. There is reason to believe that, owing to improved and increased inspection, the conditions under which potters work and their resultant mortality have greatly improved since that date.

The mortality from phthisis and respiratory diseases among

* Op. cit., p. 19.

Cornish miners is appallingly high, forming two-thirds of their total mortality. On the other hand, coal miners have a remarkably low mortality from these diseases. This may be partly due to the excessive mortality from accidents, for it is evident that any injurious effects of coal dust may not have time to operate under such circumstances. Such an explanation, however, only very partially explains the comparative immunity of coal miners from phthisis. It has been supposed, therefore, that coal dust has some inhibitory power against the development of this disease. A more probable explanation is that in the scattered work of a coal mine, the opportunities of infection by desiccated sputa are less frequent than in most of the other occupations which have been named.

It is evident from the foregoing illustrations that the breathing of impure air, especially when the air carries with it irritating dust in addition to the specific infective material, is the chief cause of phthisis. Working in a cramped or constrained position, involving imperfect expansion of the lungs, strongly predisposes to phthisis. This is shown by the high phthisis mortality among printers and tailors, among women in the hosiery and lace trade, and in sempstresses and dressmakers.

The effects of variations of the temperature and moisture in workshops in favouring phthisis are only secondary in importance. Exposure to the weather is a preservative against phthisis. Variations of temperature only cause it when accompanied by an impure atmosphere and the inhalation of specifically contaminated dust, though they may, even in the absence of such dust, favour the production of bronchitis.

Cancer and Occupation.—The causation of cancer is obscure. That it is, like phthisis, more common in certain families is well known; but there is little doubt that, as in phthisis, this means an inherited vulnerability, rather than the actual transmission of potential disease. One thing is fairly certain that persistent local irritation has very commonly preceded cancer. In cancer of the tongue or lip, there is generally a history of a jagged tooth or the use of a clay pipe. As is well known there has been in the past an excessive amount of cancer among chimney-sweeps, particularly of the scrotum, due to the chronic irritation of soot. Workers in coal-tar and crude paraffin appear also to be subject to cancer in excess of the average amount. It has been suggested by Esmarch and Langenbeck that the relation of tobacco smoke and juice to the mouth is, probably, similar to that of soot, tar, and paraffin to cancer of the scrotum. Charcoal and coal-dust do not appear to have a similar effect in producing scrotal cancer. There is a general impression that chimney-sweep's cancer is declining, but such

scanty figures as are available do not appear to confirm this impression. Dr. Ogle calculates from the figures of 1880—82 that "the liability of chimney-sweeps to malignant disease is about eight times as great as the average liability of all males." About one-half of these deaths from cancer among chimney-sweeps were from cancer of the scrotum and neighbouring parts.

Mr. Butlin, in a very interesting inquiry,* has shown that scrotal cancer in sweeps is almost unknown in the chief European countries and in the United States of America. The immunity of these countries is ascribable to the fact that hard or stone coal is not generally used, that open fireplaces are not common, and that consequently there is less soot, or a less irritating form of soot than in England. In Belgium, where hard coal and fires similar to those in England are in use, the almost complete immunity from scrotal cancer appears to be traceable to the care taken by the sweeps to prevent their bodies from contact with soot by special arrangements of clothing; and in North Germany, to the practice of daily washing the body from head to foot.

Accidents and Occupation.—Accidents cause a very high proportion of the deaths in certain industries. Happily they claim as time goes on a diminishing number of victims, as will be seen from the following data :—

Annual Death-rate from Accident and Negligence per Million persons living.

Three years	1858—60	653
Five ,, ...	1861—65	690
,, ,, ...	1866—70	678
,, ,, ...	1871—75	671
,, ,, ...	1876—80	630
,, ,, ...	1881—85	580
,, ,, ...	1886—90	544

A decrease of 16·7 per cent. under this head in the period reviewed is very satisfactory. It has been impracticable for me to obtain the necessary data for showing the proportion of this gain which has occurred in adult life; but there is no doubt that a large share of the decrease is attributable to the more efficient supervision under the Acts for regulating factories, workshops, mines, &c.

The chief incidence of mortality from accidents at all ages may be gathered from the following data for 1891† :—

* *British Medical Journal*, June 25th, July 2nd and 9th, 1892.
† Fifty-fourth Annual Report of the Registrar-General for England, p. liv.

Deaths to One Million living.

Accident.	Persons.	Male.	Females.
In Mines and Quarries	32	65	—
Vehicles and Horses	86	155	22
Ships, Boats, Docks (not drowning) ..	5	11	—
Building operations	5	11	—
Machinery	8	15	1
Weapons and Implements	8	13	3
Burns and Scalds	77	74	80
Poison, Poisonous vapours	19	27	11
Drowning	93	161	29
Suffocation	78	83	74
Falls	89	114	65
Weather agencies	10	16	4
Otherwise or not stated	64	93	37
All forms of Accident	574	838	326

It will be noted that males are two or three times as subject to fatal accident as females. The excess is especially incident upon the working years of life, but an analysis of the death returns of the quinquennium 1878—82 showed that this excess begins much earlier* in life. Under one year of age the fatal accidents of boys during 1878—82 were 6 per cent. more numerous than those of girls—a difference closely corresponding to the relative number of boys and girls living at that age. In the second year of life the accidents of boys were 30 per cent. more numerous, in the third year 51 per cent., in the fourth year 61 per cent., and in the fifth year 75 per cent. more numerous than the accidents of girls. After this age the preponderance of accidents of males becomes greater, the influence of occupation coming generally into action. The higher male mortality from accident is an explanation of the higher general death-rate of males, the total mortality from violence being too small to affect the general death-rate to any extent, and the difference from this cause being partly counterbalanced by the mortality of females from childbirth and puerperal fever.

The occupations in which fatal accidents are most common will be seen from the following statement. The mortality from all causes among all males aged 25 to 65 years of age in

* Forty-fifth Annual Report of the Registrar-General for England, p. xx.

England and Wales is taken as the standard, and of this amount sixty-seven were due to accident.

Comparative Mortality of Males, 25—65 years old (Ogle).

	All causes.	Accident.
All Males (England and Wales)	1000	67
Miners (S. Wales and Monmouthshire)	1081	229
Miners (N. Riding & other Ironstone Districts)	834	206
Miners (Durham and Northumberland)	873	196
Miners (Staffordshire)	929	172
Miners (West Riding)	772	161
Fishermen	797	152
Stone, Slate Quarries	1122	148
Cab, Omnibus Service	1482	84
Plumbers, Glaziers, Painters	1169	71
Brewers	1361	64
Innkeepers	1521	45
Costermongers, Hawkers	1879	53
Butchers	1170	35
Farmers	631	30
Wool Manufacture	1032	27

The figure for fishermen is probably below the mark because of the number drowned, whose bodies are not recovered, and who escape registration.

The diminution of accidents as the result of efficient supervision and regulations has been very marked. In the majority of industries, the number of deaths from accident is now small in proportion to the total deaths from all causes. Among all males they form 6·7 per cent. of the total deaths; among Welsh miners, they only cause 22·9 per cent. of the total deaths at ages 25 to 65. The proportion is still much too high; and when the workmen themselves are more conscientious in their abstinence from smoking in mines, &c.; when they are better educated, and more thoroughly appreciate the importance of hygienic precautions; when the hours of labour have been so reduced that the neglect arising from fatigue will not occur, as in pointsmen on railway lines, the number of accidents will shrink still more.

Even now it is against the chronic diseases due to dust and to overcrowding and to defective ventilation that the chief fight needs to be waged; and it is in this department of industrial hygiene that the largest scope for the saving of health and life lies.

Alcohol and Occupation.—The influence of even moderate doses of alcohol is in most instances to diminish the capacity for work, and more especially to diminish the power of endurance. Excessive doses of alcohol not only produce the temporary

incapacity for work, partial or complete, which is their most obvious effect, but when systematically imbibed, lead to increase of sickness and to premature death. Alcohol has been well described by Dr. Dickinson as the "genius of degeneration;" and the degenerative diseases produced by it are by no means confined to the intemperate; they are seen, perhaps, quite as frequently in those who, though never intoxicated, indulge in frequent "nips" between meals.

In certain occupations, the amount of alcoholic disease is very great. It is true that no man is compelled to drink; but in actual practice it is found that the constant exposure to the temptation to drink is almost as certain to produce chronic alcoholic poisoning, as is similar exposure to the fumes of mercury, or white lead, or yellow phosphorous, to produce the characteristic effects of these poisons. In fact, the pursuit of the occupation of a tapman or publican, in the majority of instances, implies a slow process of suicide. This will be abundantly evident from the following figures* :—

Annual Death-rates per 1000 *at Four Ages among Clergymen, Ministers, and among Publicans and Wine Merchants,* 1880–1–2 (Ogle).

Ages.	Clergymen and Ministers.	Publicans, Innkeepers, Wine and Spirit Merchants.
20—25	1·72	7·81
25—45	4·64	18·02
45—65	15·93	33·68
65 and upwards	83·96	85·81

There is no influence prejudicial to health in the life of publicans, &c., which can account for their excessive death-rate at each group of ages, as compared with the corresponding death-rates in the clerical profession, except the one factor of alcoholic excess.

The official figures of the Registrar-General give a very incomplete statement of the mortality caused by alcoholism. So long as the present objectionable method of requiring the medical practitioner to give the death certificate to the relatives (instead of sending it sealed to the registrar) is continued, there is little hope that the real facts as to alcoholism, or as to syphilis, will appear on death certificates. Were the truth known, these two great causes of disease and death would probably be found to be more fatal than all the specific infec-

* Dr. Ogle's Supplement to the Registrar-General's 45th Annual Report.

tious diseases put together; and they, especially the former, have this additional importance, that the deaths caused by them occur chiefly in the most useful periods of life. One of the commonest diseases due to alcoholism is cirrhosis of the liver; and as this is the chief cause of mortality under the head of "liver diseases and ascites," the latter may be taken as a more correct index of the amount of alcoholic excess in England and Wales than intemperance, alongside of which it is tabulated below:—

Period.	Death-rate per Million persons living from—	
	Intemperance.	Diseases of Liver and Ascites.
Three years 1858—60 ..	40·3	394·0
Five „ 1861—65 ..	41·6	416·0
„ „ 1866—70 ..	35·4	417·6
„ „ 1871—75 ..	37·6	427·8
„ „ 1876—80 ..	42·2	423·6
„ „ 1881—85 ..	48·0	372·0
„ „ 1886—90 ..	55·8	324·8

The indication of decrease of intemperance furnished by liver diseases is confirmed by the falling off in the number engaged in the liquor trade, which was equal to 17·9 per cent. for equal populations between 1871 and 1881, and to 3·8 per cent. for equal populations between 1881 and 1891.

The figures contained in the following table tell their own tale:—

Comparative Mortality Figures in Men aged 25—65 *from Special Causes (Ogle).*

	Alcoholism.	Diseases of the Nervous System.	Suicide.	Gout.
All Males	10	119	14	3
	—	—	—	—
Innkeepers	55	200	26	13
Brewers	25	144	26	9
Butchers	23	139	23	5
Commercial Travellers ..	23	139	31	6
Cab, Omnibus Service ..	33	134	16	11
Costermongers	19	207	44	3
Tailors	11	144	16	4
Grocers	10	—	17	—
Painters, Plumbers ..	12	—	—	10
File Makers	—	262*	—	—

* Including deaths from suicide.

	Liver Diseases	Diseases of the Circulatory System.	Diseases of the Urinary System.
All Males	39	120	41
	—	—	—
Innkeepers	240	140	83
Brewers	96	165	55
Butchers	96	132	55
Commercial Travellers.. ..	61	—	44
Cab, Omnibus Service	54	160	65
Costermongers	47	227	69
Tailors	48	127	45
Grocers..	52	—	48
File Makers	41	180	123
Painters, Plumbers	48	143	100

Innkeepers head the list under three headings—Alcoholism, Liver Diseases, and Gout; and in the four remaining columns they stand third on the list. Were it not for the special incidence of renal disease from lead poisoning, on file-makers and painters, innkeepers would also head the list under this disease.

Phthisis has not been tabulated above, though there is good evidence that it is increased by alcoholic excess.

Under another head, that of Accidents, alcoholism is reponsponsible for a large increase in mortality. Excluding miners, fishermen, &c., whose occupations expose them peculiarly to fatal accident, the comparative mortality from accident is higher than in most other occupations among brewers, innkeepers, and butchers. The latter must be grouped among those who suffer severely from alcoholic excess, the effects of which are doubtless enhanced by excess of animal food. They are, as a class, among those who have been described as "digging their graves with their teeth."

Effects of Excessive or Too Protracted Work.—Time is only left to briefly touch on this subject. The excessive use of any part of the body inevitably brings in its train evil results. The deafness occurring in boiler-makers and riveters; the gradual loss of power of distinguishing the varying qualities of tea by tea tasters; the localised muscular cramps and spasms, followed by palsy, occurring in writers and violinists, and in hammermen, are instances of this law.

Muscular strain from over-exertion is a common cause of hernia; and the same cause, more particularly among smiths, porters, dock loaders, &c., produces aortic aneurism. In regard to the latter condition, it is noteworthy that Dr. Drummond,

in his address in Medicine at the annual meeting of the British Medical Association in August, 1893, says that since he commenced his investigations on the subject, no indisputable case has come under his notice in which a history of syphilis was wanting in cases of true aortic aneurism. There is no doubt that, at least in a large proportion of cases, specific arteritis precedes the aneurism, and is an important determining factor in its causation.

The increased use of machinery must be beneficial by diminishing the necessity for sudden and violent exertion. The extension of work by machinery is the most prominent feature of the present century. Did time allow, it would be interesting to inquire whether the good derived from it more than balances the evils due to the increased monotony of occupation, to noise and uproar, and to the greater proclivity to accidents. As the increasing use of machinery is however inevitable, it may be more useful to congratulate ourselves that the general substitution of collective work in factories and workshops for the home handicrafts facilitates supervision of the conditions of work, and thus enables the evils arising from dust and vitiated air to be partially overcome.

The too protracted continuance of work which is not of necessity excessive, is an evil which is probably in the long run as detrimental to the interests of the master as it is to the workers. In occupations, like those of miners and railway employés, where the lives of others may depend upon the alertness and scrupulous care of the workmen, the legislature will have little hesitation in intervening between master and man. When Dr. Guy and other eminent men in 1848 advocated the case of the journeymen bakers, who demanded that they might have at least ten hours out of the twenty-four for themselves, it was objected in Parliament that "it was intolerable and impossible in a free country such as this, to apply to labour in dwelling houses and workshops a minute system of inspection and supervision such as was found practicable in our factories." The political economists were up in arms, and the continuance of "freedom of competition" without legislative restraints was advocated as the only way to sound commercial success. Much was said about "interference," and very little about humanity and justice. As Dr. Guy nobly stated the case for the journeymen bakers: "It is a bitter mockery to talk about grown-up men being able to make their own bargains. . . . The contest now going on . . . must ere long take a more definite shape between the natural feelings of a Christian man, and the cold unbending theory of a perfect freedom of human act."

Since that day the righteous sentiments of the country have

led to industrial legislation decade by decade, of extended scope and increased stringency. In the case of many shop assistants and others

> "Whose hard toil
> Doth scarce divide the Sunday from the week,"

overwork still exists, not on special occasions, but systematically and persistently, though the early closing movement is, especially in the larger shops, doing much to improve the conditions of labour. To say, as some masters do, "I can make better use of your leisure than you would," is an argument which is only fitting between the slave driver and the slave. Happily a large number of masters now realise that their relationship to their employés involves responsibility as well as profits. If they allow detrimental conditions, whether it be defective drainage, or defective ventilation or warming, or inefficient appliances for the removal of dust, or any other defect to remain, which it is within their power to remove, their responsibility for the ill-health of their employés is undoubted. One of the most important deductions from scientific teaching is that no event can be considered as *accidental*, or as the result of a mere concurrence of chances. Fixed laws co-operate in the development of every event; and given ill-health or actual disease in the employés in any shop, workshop, or factory, it is more than probable that the conditions under which they have worked for from one-third to two-fifths, or even half of every working day, have been largely instrumental in producing it.

With an increased sense of responsibility on the part of employers, we must look to the influences exerted by education, and by a higher development of the sense of responsibility on the part of workpeople, for the removal of that callousness and indifference which now form the chief obstacles to improvement. In certain occupations the production of unhealthy dust is unavoidable; and the refusal of workmen to wear respirators, or to wash themselves after exposure to deleterious dust, is a common cause of mischief.

The time is ripe for great improvements in industrial sanitation; and when the statistical history of the last decade of this century comes to be written, there is little doubt that it will record a lowered industrial mortality as the result of the present activity in improving the conditions under which the industries of this country are carried on.

MINERAL (NON-METALLIC) DUSTS, THE MANUFACTURE OF POTTERY, &c.

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A necessary prelude to Sanitary Science is to know what is insanitary.

This knowledge has now been the object of research by medical men for a long series of years, and this Institute has materially contributed towards its attainment.

All the old reputed *elements*—earth, air, fire, and water—have been scrutinised to discover what insanitary conditions are to be found in them severally. Fire comes scathless out of the ordeal and gets a place as a purifying agent, though at the same time harmful as excessive heat, and as often lending increased intensity to the action of what is insanitary in the other elements.

But earth, air, and water are ever present surrounding media often charged with health destroying energies, aroused by the play of chemical forces, and especially so when organic matter is present; and moreover acting prejudicially upon physiological structure and function by abnormal contact.

Ever extending exploration of causes inimical to bodily health opens up to our view new facts, and corrects old inferences. The ancient doctrines and theories of infection and contagion are, if not overthrown, vastly modified by microscopic research, by biological experiments respecting the minutest known organisms, and by pathological investigation coupled with wide observation of endemics and epidemics.

To students of Sanitary Science, and necessarily too of medical science, an illimitable field of study is opened out by the microscopical and biological problems thus raised. Hitherto they have rather restricted their study to more prosaic, yet most important, topics to be found in the material conditions of human existence and in the surroundings of men—especially those of man's own creation—existing in the dwellings they erect, in the ventilation provided, in the system of drainage adopted, in the food and drink they use, and in the mode of life they pursue.

But there is yet another factor in sanitation, which, in my humble opinion, has been greatly overlooked. I allude to the surroundings and conditions connected with occupation. We may secure the artisan good ventilation, good water, and watch over his food supplies assiduously, but we fall considerably short of our sanitary obligations to him, if we leave out of consideration the health aspects of his labour, and take little or no account of his workshop and its sanitation. As I remarked just now, this department of hygiene has been greatly neglected by sanitarians. And I must further add that, in the case of physicians when gathering the history of patients, small account is taken of the influence of occupation upon the health of the sufferers, and little knowledge or inquisitiveness displayed concerning the manufacturing process they pursue, or what may be their occupation. I hold, therefore, that great credit is due to the Council of this Institute for starting a course of lectures "on the Sanitation of Industries and Occupations."

It is now my privilege to bring under your notice the sanitary features of industries wherein mineral—non-metallic—dusts are generated, and to illustrate the subject by an account of the manufacture of pottery and of cement.

You will observe that in the programme issued the forms of non-metallic mineral dust selected for treatment are but few out of many. The enormous industry of coal-mining and iron-stone getting, the very large one of slate-quarrying, and the cognate occupations of stone and granite and plaster-of-Paris quarrying, and of raising and working clays for the manufacture of pottery, of tiles and bricks and other fictile products—all dusty employments — are matters outside the precribed scope of the present lecture. That which remains for examination—pottery and cement-making—is of two-fold character, and calls for separate discussion. For the methods of making china and earthenware differ entirely from those concerned in producing cement. So, likewise, do the materials used, the processes followed, the character of the dust evolved, and therewith the effects upon health.

Now scarcely any other manufacture has so strong a claim upon the attention of sanitarians as has that of pottery. It stands nearly at the head of the list of unhealthy occupations, and exercises its pernicious effects almost wholly upon the respiratory organs, by the production of bronchitis and of consumption. Thus it is found that whilst workmen engaged in other employments have a mortality from chest diseases of 7·86 per cent., potters exhibit one of 12·29. Likewise with respect to phthisis—non-potters present one of 9·27 and potters one of 12·90.

Manufacture of Pottery.—To understand the sanitation of the china and earthenware manufacture we must be acquainted with the materials employed, the processes to which those materials are subjected, and the methods of working, or the manipulations called for on the part of the artisans. Subordinate but accessory to these topics are the habits of the workpeople, the legal conditions under which they work, and the character and arrangements of the manufactories. Nevertheless, as I read the programme submitted to me for my guidance, the properties and mode of action of the dust arising from the industry in question must form the staple of my present lecture.

Bearing this limitation in mind, my observations will be first directed to the materials employed, which are all dusty or productive of dust in the processes they are subjected to.

It seems superfluous to inform my hearers that china and earthenware are made of clay; yet it is necessary to guard them against erroneous conceptions of what such clay is. It is not the familiar buff and brown aluminous substance which we daily encounter wherever we go. It is a prepared article got almost exclusively from Dorsetshire, Devonshire, and, above all, from Cornwall, and is composed largely of silica. The potter distinguishes several sorts of clay, differing in colour and in the relative proportion of alumina and silex, and which his technical skill teaches him to use in varying proportions according to the character and quality of the ware he desires to make. For instance, when he requires a larger ratio of the siliceous matter he adds what is called "china-stone." The ordinary ball and blue clay—the most akin to clay as ordinarily understood—enters more largely into the composition of common earthenware. The Cornish clays are white and like "Cornish stone" are the resultant of the action of air and water on granite rocks, producing disintegration and decomposition. This work of nature is pushed farther by human agency; the quarried material being submitted to the free action of water and air, promoted by oft repeated washings and stirring, and prolonged weathering. The product is a fine white powder resembling flour. Such is china clay, so-called because its principal application is to the making of china.

The first business of the potter is to mix the required clays together, to produce a homogeneous plastic mass—such as those who have not seen the substance in potteries may have met with in the studios of sculptors. It is familiar also as the material of which clay smoking pipes are made, hence called pipe-clay. It has the property of drying rapidly, and when dry of falling into powder.

We have got thus far:—that the basic matter for constructing pottery—the so-named clay—is very rich in silica, and that it is rendered more so by the addition of "china stone" and of flint. A strong magnifying glass or a microscope will detect in it the minute particles of silex, of irregular shape with sharp angles and points; and it goes without saying, that a dust of this description must powerfully irritate the delicate mucous membrane and epithelium of the lungs when it reaches it.

Clinical observation abundantly confirms this fact. For a considerable time the inhaled dust is arrested in its advance towards the lung tissue proper by the mucous secretion in the bronchial tubes, and by the expulsive energy of the cilia lining those tubes. But at length these resistant forces weaken before the constant entry of fresh dust, and in course of time the noxious material passes into the lymph channels, and also along the finer bronchi, until it reaches the intimate structure and the air-cells themselves. Here as a foreign substance it sets up inflammatory action; lymph cells spring up, the air-vesicles become choked with inflammatory products, the tissue around them gets indurated (lung sclerosis), and useless as breathing tissue.

The history of these pathological changes is reflected in the symptoms exhibited by the sufferers. In the primary stage little inconvenience is felt: there arises a desire to clear the throat of some impeding mucus at the end of the day's work, or upon transition to the outer air from the warm shop, and especially on rising in the morning. This expulsive act soon develops into a cough, and relief is obtained by the expectoration of more or less blackish viscid mucus. Presently there is a feeling of tightness in the chest, and the breathing grows less free and full. As time goes on these signs of disturbed lung function become more pronounced, and in the end the patient grows asthmatic—a victim of potters' asthma.

Until this advanced stage of disorder is reached, it is singular to notice how little attention and anxiety are bestowed upon the pulmonary derangements. This is because the general health is, for the most part, not seriously affected, and inasmuch as whilst the sufferer breathes a warm air in his workshop or home, his lung trouble is felt as little more than an annoyance; or as something which is to be taken as a matter of course, and like his wages, as an unavoidable incident of his calling.

As with chronic maladies at large, so with potters' bronchitis and asthma; the tendency is to grow worse and the lung lesion to extend, and soon the damaged respiration reacts upon the whole frame; the sufferer cannot get proper outdoor exercise,

his appetite fails, his sleep is broken, the expectoration augments and grows muco-purulent, the body wastes slowly, whilst the increased effort to breathe entails strain upon the heart, leading not infrequently to disease of that organ, with the after-consequences in the shape of dropsical effusions.

We now have before us the fully developed disease known as potters' consumption or potters' asthma.

The shortness of breath sanctions the use of the term asthma; whilst the existence of cough, expectoration, and wasting, is suggestive of the appellation consumption. Still these terms are not rightly applicable to the actual lesion present. The morbid changes are not those of tubercular disease, and the symptomatology is diverse. At the same time, it must not be lost sight of that the tubercular lesion may be, and not infrequently is, a concurrent condition; nor that those predisposed to consumption are likely to have that malady lighted up by the dusty employment they follow.

To return to the processes followed in the making of pottery. The selected clays with the usual addition of a certain proportion of powdered flint, are mixed with the water to make a thick semi-fluid, called "slip." To render this fit for after processes, its excess of water must be got rid of. This formerly was done by evaporation in tanks aided by constant stirring. It is now effected in specially constructed machines, whereby the water is expelled by pressure. By either method a plastic material is produced, ready to the hands of the potter who moulds it as he sees fit.

We may reckon pottery to be the earliest industry pursued by man; vessels for eating and drinking were essential things; tenacious clay was almost everywhere accessible, and its readiness for modelling into any shape immediately perceptible to the simplest aborigines. Hollow vessels were a primary desideratum, and it needed but little observation to discover how easily these could be formed by a whirling or rotary movement with pressure about a fixed point. Hence soon arose the invention of the potter's wheel, a piece of mechanism that has come down to us from the remotest ages—modified little in detail, and ever the same in principle.

The artisan who works with the potter's wheel is called a "thrower," for he throws a mass of clay upon the rapidly revolving axis or central disc, and by skilful manipulation moulds it into the required shape. Owing to the mechanical features of the apparatus he uses, his business is the making of "hollow-ware," including cups.

Modern invention has greatly curtailed the work of the thrower by introducing the processes of "*pressing*" and of

"*casting*." Hence two new classes of operatives have arisen, known as *pressers* and *casters*—the former constituting the most numerous division of pottery artisans, and, what is regrettable, the greatest sufferers from their occupation.

They are divisible into two classes, called respectively hollow-ware and flatware pressers, according as they make hollow-ware, such as jugs and vases, or flatware, such as plates. Both alike employ a twirling disc, known as a "jigger," but in other respects their operations differ. The hollow-ware presser constructs his jug within a mould of the requisite shape, divisible into halves; whereas the flatware presser spreads a thin lamina of clay upon his flat mould resting upon his rapidly driven jigger, and proceeds to smooth the surface and edges. The mould used determines the shape and size of the article made, and also absorbs much of the moisture of the clay.

The article, as yet in a soft state, has next to be slowly dried. This is done in a closet situate behind the presser, the transfer being made by boys, who from their work are called "mould runners." In former years the jiggers were turned by hand, but at the present day are mostly driven by steam power.

The surface of ware as it leaves the hands of the throwers and pressers does not possess the smoothness required, and has to undergo other operations before it goes to the oven. These are sponging, friction with sand-paper, or turning. The first method needs no elucidation. The second, that of rubbing with sand-paper or some substitute, has grown, in the case of flatware, into an operation of considerable magnitude, and one of first-rate importance in relation to the health of the workers. Owing to "tow" having been first employed it acquired the appellation of "towing." It is done on a rapidly revolving "jigger," the tow or sandpaper being pressed by the hand on the surface of the flatware to be polished whilst in the biscuit state. It will be at once understood how great must be the dust thrown off by this proceeding. So great and fraught with injury was it, that regard to humanity and the health of the employed called for some provision against its patent evils. Happily the inventive genius of Mr. Turner, a manufacturer at Tunstall, suggested a simple plan of doing this work in a nearly enclosed box, provided with a strong current of air, produced by a fan, to extract and remove the dust as it arises, and thus prevent its diffusion on and around the workpeople. By this mechanical expedient this dusty process has, to a great extent, been rendered innocuous.

The operation of "towing" is specially applicable to flatware, plates and saucers. Where hollow-ware has to be duly smoothened, its surface is either sponged with a damp sponge, or

otherwise is passed to a "turner," who finishes the surface by means of a lathe worked by a treadle, in the same fashion as a wood turner deals with the objects submitted to him.

The "pot-turners" constitute a special class of artisans, but not a numerous one. The treadles are worked by women and girls, who keep up a constant jumping action with one leg—a proceeding that is suggestive of evil to them, particularly when young and not strong. We, however, are justified in looking forward ere long to the displacement of this primitive way of giving motion to the lathes by the substitution of machinery. Indeed the change has already come about to a small extent in modern factories.

Here I am led to remark, that the application of machinery moved by steam power has, in the history of pottery, been of very slow growth. Forty years ago it was unknown, and up to the present time human labour contributes a very large proportion of the moving force required in many processes. The nature of the material, by its brittleness as it becomes dry, forbids indeed its application in many operations. Nevertheless, every year witnesses the extension of the use of machinery in the trade. Owing to the brittleness of clay in a dried or nearly dry condition, and its ready reduction to a pulverulent state, all who deal with it are exposed to its dust. And besides the larger operations previously alluded to, there are lesser ones falling to the lot of clay-workers. Principal among such are the handle and spout-makers, the sand-paperers, and the varied helpers whose special business is to clean off irregular and redundant fragments upon the ware. These cleaners are, in the language of the trade, called "fettlers." However, no special description of these people and their work is necessary; the primary agent for evil is the dust, and happily this evil is inconsiderable in the sundry minor divisions of labour adverted to.

Powdered flint is also largely used in the manufacture of pottery, though chiefly in china-making, where its main use is to pack the china within the boxes called "saggars," in which it is fired in the ovens. The filling in of the saggars with powdered flint is the work of the class of men named "placers." Their work is less continuous than that of flat pressers, and in consequence their exposure to dust is not so great, though, at the same time, the dust inhaled is even more harmful than that of clay alone. It is a common thing for placers to act likewise as oven-men and kiln-men, and so to incur the additional risk attendant upon the drawing of ovens and the emptying of saggars.

There is still another class of workers among whom flint dust is pre-eminently a cause of sickness and death. These are the

china-scourers—all women. Their business is to brush off the flint which has adhered to the china in the operation of firing. The quantity is considerable, and in its removal by brushes a cloud of dust is thrown off, which, if not diverted from the respiratory orifices, enters the lungs and there works most serious mischief, setting up fibrosis and rapid consumption. Of all the operations pursued in the making of pottery, this one is the most destructive to health and life. Within a few years these scourers, if not dead outright, are broken-down women on the highway to the grave. Fortunately, compared with the whole number of hands in a china factory, they are few in number. The occupation ranks as about the lowest in the series of pottery avocations, for it is one that needs no special training, and, consequently, like other unskilled work, falls into the hands of the least instructed, and the least concerned with sanitary scruples and social considerations.

Another and far more important material used in pottery manufacture is *lead.*

This is employed in the form of the white carbonate or of the red oxide of lead; the former most frequently. These and other salts of the metal are most common constituents of colours used in decoration; whilst others, principally the chromates, are themselves actual colouring materials.

But the special use of red and white lead is—in conjunction with borax and china stone fired together in a kiln—to make an enamel to coat the ware, to give it smoothness, and to render it non-absorbent. The glaze or enamelling fluid is put on after the first firing of the ware, when it is in the condition known as "biscuit." In this state it is porous, absorbent and unfit for use.

The glaze is applied in a liquid state by simply dipping the ware in it; and the workmen occupied with this process are called "dippers." It very rapidly dries on the surface, some portion being absorbed. The very rapidity of drying causes much of the evil attending the operation; because it leads to the formation of a fine coating of dust readily diffusible. This fact in conjunction with the mode of working, wherein the hands and arms of the dippers are almost incessantly plunged into the glaze, will account for the prevalence of lead poisoning or plumbism in this class of workmen. For we cannot fail to recognise the inevitable absorption of the poison by the air passages in the shape of dust, and by the skin from immersion in the liquid.

A great effort is being made at the present time—promoted especially by the Home Office and the Factory Inspectors—to abolish if possible the use of lead in glazes; or, if this be not

practicable, to diminish its employment and to guard against its poisonous properties. To attain these most desirable ends many glazes devoid of the metal, or nearly so, have been submitted to manufacturers, who, however, have not yet been induced to use them, in the absence of sufficient experiments and experience to justify them in so doing. A more practicable way of lessening the serious evils of the poison is suggested, viz., by the use of fused lead glaze only, without the usual addition of raw white lead. The value of the suggestion is now being fully tested, and it is to be hoped that a great reduction of the serious evils connected with the glazing of ware will reward the trial.

But even supposing the use of lead cannot be dispensed with, experience unmistakeably proves that its serious results may be very largely mitigated by greater attention, on the part of the artisans themselves, to cleanliness in person and in working. Men can be found who have been dippers for ten, twenty, and even thirty years, and have escaped the direful consequences of their occupation, entirely or nearly so. Such men are the careful and clean workers, and men who lead steady lives.

It requires personal observation to realize the carelessness and recklessness of workpeople who perfectly understand the danger of their calling, but who will eat food exposed to the contaminated air of the dipping-house, and this often with unwashed hands; or who will take little or no pains to cleanse themselves and their clothing on leaving work, or who will neglect to properly protect themselves from the bespattering glaze by suitable coverings. For such persons the interposition of factory regulations is urgently needed.

Much more might be said on this subject of lead as used by potters, and of the consequences attendant thereupon. But I forbear, knowing how fully and forcibly the subject of Plumbism will be placed before you by my distinguished colleague in this course of lectures, Dr. Oliver, who has made it a special study and employed the best advantages furnished in this country.

There is yet another ingredient that enters into the composition of china, not so directly chargeable with injury by its dust. I mean calcined bones of horned cattle. These are finely ground and mixed with the clay to form the "*body*" of china or porcelain ware. The bone gives transparency and lessens the brittleness. It is an expensive component, and on the continent is replaced by felspar.

This last-named substance is, in England, principally used in the production of "Parian" goods—mostly figures; but no facts are in hand to indicate how far its dust is prejudicial.

I have said that the powder of the calcined bones added to

make the body of chinaware is of small consequence hygienically. Still it is but right to remark that bone dust proves very irritating to those who have to mix it, and that, besides its mechanical action, an annoyance often arises from a pungent offensive odour it gives off. Moreover, practical potters assure me that the compound of clay and bone dust, as used in china-making, exhibits a caustic and destructive quality not found in clay itself. It softens and destroys the wooden troughs of the throwers, which have in consequence to be faced with lead, and it is corrosive to clothing.

These mischievous properties one is inclined to assign to the nature of bone dust as a phosphate of lime; and as the dust of china-making is admittedly more noxious than that of the manufacture of earthenware, one cannot resist the impression that, over and above the harm attributable to a higher percentage of silex in china, additional injury arises from the calcined bone as an ingredient.

To justify this allusion to bone dust in the category of mineral dusts, it is almost needless to say that in pottery it is only the mineral element of bones, after complete calcination, that is dealt with.

To proceed. There is yet another mineral dust encountered in the pottery industry. I allude to Plaster of Paris, which is very extensively used in the making of moulds and models. But though readily diffused around the workers, it does not penetrate into the lung parenchyma as does ordinary potters' clay dust, and its pathological results are not nearly so conspicuous. It is conceivable that this circumstance is owing to its strong affinity for water, and its consequent arrest by the moist ori-nasal and bronchial mucous membrane, ere it can penetrate to the finer tissue of the lungs.

Having now passed in review the various mineral dusts connected with the manufacture of pottery—earthenware and china—and noted the processes wherein those dusts are evolved, it seems necessary, in addressing the members of a Sanitary Institute, whose primary purpose is to devise sanitary remedies, to say something respecting measures calculated to remove the evils of the trade, or at least to mitigate them. Those evils are very obvious, and unhappily their consequences are no less so. The business of the potter stands nearly at the head of the list of unhealthy trades, and it is an imperative duty to endeavour to give it a better position.

The insanitary factors are the mineral dust of clay, of silex, and of lead; subordinate to them are high temperatures, and the dusty and smoky atmosphere of a trade which demands a prodigal use of coal.

The dust of clay and flint operates directly on the breathing organs; hence our efforts must be directed to obviate its entrance into the respiratory passages by mechanical means. These means consist in, first of all, providing efficient ventilation in workrooms, and next in devising apparatus to prevent dust diffusing itself on and around the workers, and to withdraw it altogether from the shops. Until recent times such measures have been totally neglected, or attempted by very ineffective arrangements. Now pressure exercised by the factory inspectors and strongly seconded by aroused public opinion, has had the effect of rapidly introducing modern schemes of ventilation into factories, and also inventions to remove dust from the point at which it is generated. To accomplish these ends the chief instruments employed are ventilating and extracting fans. I cannot here enter into details of the mechanism adopted. Indeed, such a course is not called for, because present plans are but more or less tentative, and we may look for important modifications and improvements as the result of experiments. One drawback to the more general adoption of mechanical appliances, is the absence in numerous factories of motive power supplied by steam or gas or electric engines; an absence largely attributable to the smallness of the works and want of capital, and to the frequent irregular arrangement of detached shops and the consequent difficulty of conveying power.

Nevertheless, the future course to be followed to improve the hygiene of the potter's craft is sufficiently plain, and engineers and architects need give much more attention to the subject than they hitherto have done.

Respecting the subordinate factors of ill-health among potters little need be said. The regulation of the heat of workrooms is very much a matter of ventilation and of construction. The heat emanating from the closets wherein the ware is first placed can be moderated by care, and lessened by ventilation of the closets themselves; and that of the shops can be reduced by alterations in their construction and disposition, and by ventilating arrangements.

The introduction of steam and hot water pipes for warming the shops, in place of the old-fashioned stove pots, has operated injuriously upon the health of the operatives: because, for the most part, whilst securing warmth, it has been at the sacrifice of ventilation.

The enormous combustion of coal in firing pottery, and the dust and smoke attendant upon it, represent evils which we may yet hope to see removed, by the adoption of gas in place of the crude coal. Experience in America and elsewhere has proved the applicability of coal-gas for firing pottery, and nothing

more is now wanted than the inventive genius of engineers to contrive arrangements for substituting gas, which shall be both efficient and economical.

Another factor of no mean importance in relation to the occupation of potters is found in the habits of the workmen themselves. It is, as said before, particularly prominent in the instance of those who are brought into contact with lead, in whose case experience sufficiently proves to how great an extent care and cleanliness in work and dress, temperate living, and the use of some simple prophylactic expedients, will enable them to proceed with their task unaffected for a series of years.

All this is generally and equally true of every other department of the potter's business. In short, much of the sickness and mortality of the trade is avoidable by care, cleanliness and temperance; and without these qualifications, no mechanical arrangements and no official rules can be successful in obviating the evils of this calling.

The Manufacture of Cement.—This is a manufacture of no inconsiderable dimensions, although the numbers employed in it are not great.

The material made is known as Portland cement, and is an artificial product serving the same purposes as does Roman cement, which is a natural product found in volcanic deposits.

It has been a greatly persecuted form of industry, driven from the habitations of men to outside places, where, excepting the workers themselves, population is sparse, the surrounding land comparatively valueless, and the chances of prosecution for public nuisance and for destruction of crops are but few.

All this has followed from the malodorous and destructive vapours thrown off in the course of manufacture, and magnified by public sensitiveness and prejudice.

Let me first say what cement is in its composition. Chemically speaking, it is a mixture of carbonate of lime and silicate of alumina; or a double silicate of lime and alumina coloured by oxide of iron. The rough components are carbonate of lime (usually chalk), flint and clay, the last being of a selected tenacious character, and obtained from ancient lake bottoms, from river beds, and like places of past or present subsidence.

The first process is to grind the clay in a mill resembling a mortar grinding machine. After that the necessary portion of flint and lime are added and worked up together with water into a mud-like mass.

Formerly the amalgamation of the raw materials with water was done in tanks with the aid of heat, and after very prolonged stirring and time to allow settlement, the material was

submitted to a process of wet grinding, and ultimately calcined in open-topped kilns.

Now the mud-like material is spread over the floor of large vault-like chambers, heated by a furnace at one end. After being there duly dried and subsequently calcined, the cement is ready for grinding between mill stones. The aim is to reduce the compounds to as fine a powder as possible.

Few manufacturing processes are more simple in principle. A semi-liquid mud is prepared and thoroughly mixed, then dried and calcined, and afterwards ground in a mill. Nevertheless, it presents possible causes of illness, both by heat and dust.

For example, a very high degree of heat is attained in the drying chambers or vaults, and when it has done its work, the residual dry cement has to be removed by shovels and sent up to the surface. As the excavation is piecework, and a speedy emptying of the chamber desirable, it is common for the labourers to descend into the chamber before the material has sufficiently cooled, and thereby to suffer exhaustion due to heated air conjoined with strong physical exertion, within a confined space, and some gaseous products not quite innocuous. As a matter of course, the excavation of the dry cement is attended by considerable dust; though to a less degree than the subsequent operation of grinding.

The dust generated in either way is highly irritating to mucous membranes, and causes heat and smarting of the eyes, and still more of the nose. In the case of the latter organ the irritation advances to local inflammation, and presently to ulceration, which especially attacks the septum of the nose, and ends by producing perforation. Farther destruction of tissue follows should work be continued and no efforts at treatment be made. This partial destruction of the *septum nasi* is a lesion well-nigh peculiar to cement makers. It is brought about by the irritating dust which clogs the nasal passages and provokes efforts to dislodge it by the finger nail, with consequent aggravation and extension of the ulcerative inflammation already set up.

The character of the dust cannot fail to prove highly irritating to the mucous membrane of the air passages, but thanks to protecting coverings of the mouth and the remarkable affinity of cement for water, almost the whole of it gets interrupted in the nose where it forms a plug, the expulsion of which is impelled both by the volition of the individual, and by automatic or reflex action. It must however be admitted that some of the finest particles do, in course of time, penetrate to the larger bronchial tubes, and eventually produce cough and shortness of breath, or a chronic bronchial asthma.

In this occupation of cement-making there does not appear

to be much scope for sanitary appliances. Still something might be done in the grinding department to obviate the diffusion of dust. It may be urged that in the case of cement-mills the number employed is insignificant; but, if this be true, humanity imposes the onus upon proprietors to lessen, if not to altogether remove, a tangible cause of sickness; and the example of flour-mills, to some extent at least, indicates how it may be done.

In all dusty trades there is a simple expedient against dust inhalation found in the wearing of a respirator; and it is one that would seem to be well calculated to effect that object. In very many occupations, indeed, respirators are applicable, and would be far more so if improved and specially constructed to provide against the breathing of dust. Unfortunately this specially adapted character is not one commonly met with; for in their construction the principles necessary to make good respirators for sick folk who only want protection from cold and damp air, are those followed. The fine wire-gauze is not essential; it does not intercept fine dust, and the firm frame is only an impediment to the close adjustment of the dust-filtering material to the depressions about the mouth and nose.

The gauze with the inserted film of wool gets speedily choked with fine dust mixed with the moisture of the breath; and the whole apparatus impedes free expiration and inspiration, and when choked is not readily cleansed. A respirator must not be rigid, and its essential part to oppose the inhalation is a film of cotton wool, so stretched and supported over the mouth and nose, that it lies in immediate apposition with the cutaneous surface of the face around them. For a long series of years I and others have tried assiduously to get pottery workpeople exposed to dust to wear respirators, but with so little success that our endeavours must be accounted failures. The freedom of breathing is so embarrassed by them, and what seems of more account, if our female workers do not deceive us, the freedom of talk also, that they prefer to breathe dust rather than to wear them. Another objection arises from the inherent sense of beauty lodged in the breasts of all ladies; a sentiment seriously offended by the enclosure of the mouth by an ugly respirator, which is contemptuously called a muzzle, and which, in the presence of unmuzzled workers and their jests, only singularly strong-minded individuals can persevere in wearing.

Those who have favoured me with their attention to this discourse on the making of pottery will be disposed to ask, why I have said nothing, or next to nothing, of the ornamentation of ware by the processes of printing, gilding and colouring—

processes constituting the business of finishing or decorative department. The omission will seem so much the more glaring when the large number of hands employed in that department is taken into account; for the number so occupied equals, if indeed it does not surpass, that of those working in the clay-department. But the fact is, that the ornamentation of pottery by painting and gilding, is a form of work differing entirely from that of pottery making properly so called; though in almost all cases the two kinds of occupation are pursued in the same buildings, and those engaged in them get grouped together under the general heading of potters.

The hygienic features in common are: indoor labour, the use of lead, and, in the case of a small band of workmen, exposure to heat. Respecting the first-named no remarks are needed. In the matter of lead, the hands engaged in decoration are in injurious contact with the poison, in the form of colours in majolica painting, in "ground laying," and to a very small extent in ordinary enamel-painting. Lastly, as to exposure to heat, and omitting that experienced in working in hot shops, the two departments meet on common ground in kiln-work—a process of firing required to fix and make permanent the gold and colour decoration used for ornament. At the same time the conditions of labour in kilns and in ovens are not alike; those in the former being far less severe, considered in their hygienic bearings.

The sanitary features of the decorative and finishing department exist, however, in a pre-eminent degree, in the conditions more or less inseparable from sedentary labour. Such are the sitting posture with the body more or less inclined forward, the want of muscular movement necessary to healthy respiration and circulation and to muscular nutrition, and lastly, confinement in shops too frequently over-heated and under-ventilated, and fouled by the breath of numerous workers and by the products of gas combustion.

These factors are common to all sedentary occupations and need not be enlarged upon by me, although in the department of work in question they are the most weighty from a hygienic point of view.

I will now conclude by cordially thanking my hearers for the patient attention with which they have favoured me, and trust that I have succeeded in elucidating the sanitation of the pottery manufacture, as far as the compass of a single lecture would permit.

METALLIC DUSTS, CUTLERY, TOOL MAKING, AND OTHER METAL TRADES.

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I HAVE selected the cutlery and file trades for my lecture, partly because they are industries which find employment for a large number of workmen in the district in which I reside, and I am thus able to speak of them from personal observation; and partly because they illustrate in several ways the need which exists for drawing the attention of the community in general, and the Legislature in particular, to defects in the sanitation of occupations.

These trades are of a highly specialised character, necessitating a long apprenticeship before proficiency is attained: and as in the majority of instances the callings have been handed down through many ancestors, the workmen may be said to possess hereditary qualities, whether for good or evil, incidental to their occupations. Then they are quite free from the adulteration of casual labour, and for this reason statistical evidences concerning them possess a relatively high value.

I propose to pass in review the special risks to health to which the workmen are exposed, the sanitary conditions under which they work, the evidence bearing on their health furnished by mortality and other returns, the factory legislation as applied to these trades, and, lastly, suggestions for remedying or ameliorating existing evils.

At the outset I gratefully acknowledge my indebtedness to the manufacturers and workmen of Sheffield for the uniformly courteous and frank reception they accorded me while gathering material for this lecture.

The manufacture of cutlery comprises a number of wholly distinct processes, each of which is interesting; but from a sanitary standpoint it is only necessary to refer at length to a few of these.

In the production of the best cutlery the first process is that of forging the blade out of a bar of heated steel. Inferior blades are frequently stamped or "flied" out of thin sheets of metal by means of machinery; while the lowest class of all is made out of a substance called "sow metal" cast in moulds.

Forging may be done by hand or by the aid of a steam hammer. Hand forgers are a muscular, healthy class of workmen; and their calling, which is very similar to that of a blacksmith, presents nothing requiring special comment.

After the blade has been forged it receives the mark of the manufacturer, and is then tempered and hardened, these processes being commonly done by the forger. It is next passed on to the grinder, who reduces it to its proper shape and thickness and gives it its cutting edge. Grinding is done on circular stones, turned either by steam or water power. The stones vary in diameter from one or two inches to several feet, and are of different degrees of hardness, according to the nature of the work required of them.

From a sanitary point of view grinders may be divided into two classes known as "wet grinders" and "dry grinders."

Dry grinders are engaged in grinding steel forks, augers, gimlets, needles, and a few other articles. They form a comparatively small class of workmen, but owing to the excessive mortality which formerly obtained among them, they have long attracted the attention of the trade sanitarian. The attrition of the steel against the dry grinding stone gives rise to enormous quantities of steel and stone dust, which is very irritating to the lungs, and produces a pathological condition known as grinder's phthisis.

At one time dry grinding was, perhaps, the most unhealthy trade in the country. The late Dr. J. C. Hall, of Sheffield, in an admirable paper read before the Social Science Congress in 1865, stated "that, excluding boys, the average age of dry grinders was only 29 years." Of late the introduction of fans for carrying away the dust has greatly improved the conditions under which dry grinders work; and, as I shall presently show, this has been followed by a corresponding improvement in health and length of years, but the trade is still an unhealthy one.

Wet grinding is much the more important branch of the grinding trade, and gives employment to several thousand workmen in Sheffield. The grinding stone passes through a thin layer of water during its revolution, and the process is comparatively free from dry dust; but it is accompanied by other evils almost as great as those incidental to dry grinding.

The grinding stones are constantly throwing off water, which

soddens the floor and saturates the air of the grinding room. The damp atmosphere in which wet grinders work undoubtedly conduces to the appalling mortality from phthisis and other lung diseases to which they are subject. Two other factors must be mentioned which contribute to the same end. One is the stooping, constrained posture which many grinders assume as they sit astride their grinding stones with the elbows resting on the thighs; the other is the stagnant condition of the air of the grinding room, which in many respects resembles that of a damp cave.

Certain articles of cutlery are ground partly on a wet and partly on a dry stone. Thus the backs of razors and scissors and the bolsters of table knives are ground dry, while the rest of the blade is wet ground. The dry process is however of relatively short duration, occupying less than one-sixth of the entire time taken to grind the blade.

There is another process connected with grinding which gives rise to enormous volumes of dry dust. The grinding stones are received from the quarries in a rough condition, and the grinder, after mounting the stone on its axle, reduces its circumference to the proper shape and degree of smoothness by applying a bar of steel to it while it is revolving slowly. This process, which is known as "racing the stone," occupies less than half an hour; but while it is in progress, the air of the room near to the stone is almost unbreathable. All stones, whether for wet or dry grinding, require to be "raced" in the first instance.

Another danger to which grinders are exposed is the breaking of the grinding stone. These accidents are unfortunately common, and often cause frightful injuries and death. They are due to a variety of causes, such as departure from the circular shape owing to one side of the stone wearing faster than the other, flaws in the stone, allowing a portion of the stone to remain in water when not in use, fixing it on its axle by means of wedges instead of using plates and screws for this purpose, and permitting the stone to revolve too rapidly.

Most articles of cutlery after being ground are "glazed." This is done on a wooden wheel covered with leather, which has received a coating of emery and glue. The rim of the wheel is from time to time rubbed with a cake composed of emery, suet, and bees-wax. The glazer is used for the purpose of removing the marks left by the grinding stones, and, owing to the greasy nature of its surface, there is not much dust formed.

Behind the glazer, and in the same trough with it and the grinding stone, is a third wheel known as "the polisher," which

is employed to give a highly finished appearance to certain blades. The polisher is also made of wood and covered with leather, but instead of emery a fine powder containing oxide of iron, and known as "crocus," is used with it. Polishing gives rise to a considerable amount of dust at a part of the room where the ventilation is especially bad. Glazing and polishing are usually done by apprentices.

The blades of pen-knives and many razors are subjected to a process called "lapping," which is done on a lead-rimmed wheel called "a lap." The process is of interest as being a possible source of lead poisoning; but I have failed to find any-one showing evidence of plumbism from this cause.

The next process is that of hafting, and this work is done by a class of men called cutlers.

The healthiness or otherwise of a cutler's occupation is to some extent determined by the class of work he does. Thus workmen who haft in ivory and tortoiseshell, work under more favourable conditions than those engaged on inferior material, such as wood and bone.

This difference is due to the fact that the former class do most of their work with a file, and produce little dust; whereas the latter shape the knife handles on an emery wheel, known as "a cutler's glazer," and produce clouds of dust, composed of steel particles from the rivets and tang, of emery from the dry glazer, and of bone or other material of which the handle is made. The cutler's glazer is a comparatively recent invention, having come into general use only during the last twenty years. Previous to then all handles were shaped with a file. It is most injurious when used for shaping the hafts of knives that have scale tangs, because the projecting portions of the tangs have to be ground down by it.

The cutlery manager of one of the largest firms in Sheffield assures me that cutlers, as a class, have become much more un-healthy since the introduction of the glazer. This opinion has been endorsed by other competent observers; and there is no difficulty in accepting it if we reflect that the modern scale tang cutler, when using a glazer, is virtually a dry grinder.

The bolsters of inferior knives are often made from an alloy of lead and zinc, which is cast on the blades and subsequently ground to the proper shape on an emery wheel. During the grinding process much dust is given off, and being inhaled by the workmen occasionally causes lead poisoning and death.

Files and rasps are largely manufactured in Sheffield and the surrounding districts. In Sheffield alone the industry gives employment to more than 4,000 workmen, besides a large number of females.

The principal processes in the manufacture of files are forging, annealing or softening, grinding on a wet stone, file cutting, and hardening. Of these file cutting and file hardening only need detain us.

File cutting may be done by hand or by machinery. Of late the proportion of machine cut files has steadily increased, but by far the greater number are still hand cut; and in this process more workmen are employed than in all the others conjoined.

Hand file cutters are exposed to two special dangers to health; one of these arises from the overcrowded and badly ventilated rooms in which they work, and will be fully considered when I come to discuss the sanitary condition of the workshops; the other is due to the employment of a lead bed on which the files are cut, and is a terrible scourge to the trade.

The teeth of a file are produced by means of a chisel and hammer; and to afford a firm bed for the file and reduce vibration, a block of lead is placed underneath the file. The non-elastic character of lead eminently fits it for this purpose, while its comparative softness prevents it from injuring the teeth of the file when the reverse side is being cut.

At each stroke of the hammer a fine cloud of dust containing much lead rises in the air, and as the file cutter sits with his face directly over the anvil he must perforce inhale some of this lead dust. Moreover, his left hand which holds the chisel is almost always resting on the lead block from which it receives a coating of lead, and in a great many instances some of this finds its way to his stomach at meal times. Nor is this all, a practice exists among certain file cutters of moistening from time to time the end of the left thumb at the lips, so as to secure a better grip of the chisel. This habit I am pleased to learn is dying out, but where it is practised it is a potent method of introducing lead into the body.

The ill effects resulting from the employment of lead in file cutting are only too well known. Colic, paralysis of the extensor muscles of the wrist and thumb, gout, and Bright's disease, are the most evident of its protean evils; but long before it produces these definite maladies its influence on the body is both seen and felt. The sallow anæmic countenance presented by the file cutter is almost characteristic of his calling, while enquiry will often elicit a history of constipation, indigestion, and bodily weakness, long antecedent to the development of more alarming maladies.

It is reasonable to suppose that file cutters who neglect to wash their hands before eating, and who are otherwise careless, will suffer from lead poisoning to a greater degree than those who are more careful in their habits.

But while this supposition is no doubt true as a rule, it admits of numerous exceptions, and one is driven to the conclusion that idiosyncrasy of constitution renders certain workmen highly susceptible to the pernicious effects of lead, while it enables others to effectively resist its power. In no other way can I explain some facts brought out during my inqniry. Thus a highly intelligent workman informed me that he was the oldest of five brothers, all of whom were file cutters and careful in their habits, yet four of these had died from the effects of their trade, and he himself had had lead colic. On the other hand, I have examined workmen who expressly stated that they were indifferent as to precautions, and yet were in good health after forty and in one instance after fifty-five years of file cutting.

These anomalous cases are serious stumbling blocks in the way of improvement, because they are sure to be quoted by file cutters when they are urged to take more stringent precautions against lead poisoning.

By way of sampling file cutters I examined one hundred men taken haphazard as I met them in their workshops. Their average age was thirty-seven years, and they had been working at their trade on an average for twenty-three-and-a-half years. Seventy-four had a lead line on their gums, twenty-eight had suffered from lead colic, and twenty had at some time been afflicted with paralysis of the wrist or thumb.

These figures, however, do not show the full extent of the mischief, because file cutters when they become seriously paralysed in the wrist are unable to follow their employment, and either take to some other calling, or too frequently become a burden to the community, until a life of decrepitude and disease terminates in premature death.

Although lead is well known to produce paralysis of the wrist and thumb, it would appear to be probable that in the case of the file cutter these affections may sometimes be partly due to the excessive use to which the muscles of the wrist and thumb are put.

The rapidity of a file cutter's movements is perhaps unsurpassed by that of any other handicraft, while the muscular energy produced in the heavier branches of his calling is truly phenomenal.

A deft workman will cut from 100 to 260 teeth per minute, using a hammer which ranges from nine pounds to a few ounces in weight, according to the size and character of the file. In cutting large files a workman will, in eight hours, develop in his right arm muscles alone sufficient energy to raise from 150 to 200 tons a foot high.

Machine cut files are frequently cut on lead or an alloy of

lead and zinc, but there is little contact with the lead on the part of the machinist. I have examined a number of machine cutters in order to ascertain if they suffered from lead poisoning. The problem is complicated by the fact that many machine cutters were formerly hand cutters; but my observations lead me to the conclusion that machine cutting rarely, if ever, gives rise to this malady.

File hardening is most commonly done by heating the files in a coke fire and afterwards plunging them in a brine bath; but occasionally they are heated in a bath of molten lead, while a lead bath is universally employed for softening the tang of the file.

It is popularly supposed that the fumes arising from the molten lead are productive of lead poisoning, and I have had hearsay evidence of several men who it was said had died from this cause.

I have, however, failed to find direct evidence verifying this supposition. An examination of twenty file hardeners who used the lead bath, did not produce a single instance of lead poisoning. Three of these men had a lead line on their gums, but all three had formerly been file cutters. The point seemed so important that I deemed it advisable to examine the vapours given off from the molten lead; and I accordingly drew through water in a wash bottle several cubic feet of air taken from the surface of the bath while it was being used, and had the water analysed. Several experiments of this nature were conducted; but in every instance the water was found to be free from lead. Other investigations bearing on the same point yielded negative results; and it would appear to be fairly certain that the lead baths do not give off the vapour of lead or of its oxide, and are therefore unlikely to produce lead poisoning. It is only right to add that the molten lead is covered with a layer of fine coke; and to this agency the workmen attribute their immunity from lead poisoning.

I have now to describe the sanitary conditions under which these trades are carried on; but before entering on this subject it is desirable to mention the peculiar arrangement existing between workmen and the owners of the majority of cutlery works. The workmen are usually piece-workers, and, whether they work for the owner of the premises or for some one else, pay a weekly rental for their troughs or benches and the necessary motive power. They find their own tools, and are virtually joint tenants of the rooms they occupy.

Grinding may be done in separate buildings which are known as "grinding wheels," or on the premises where the other branches of the cutlery trade are carried on. In either case the

grinding of heavy articles is conducted on the ground floor. The rooms or "hulls" as they are called are sometimes sunk below the level of the ground, and are, as a rule, bounded on three sides by blank walls, without adequate means for cross ventilation. The windows and door are in the fourth wall, and the former are usually devoid of glass, because the mud from the grinding stones would speedily obstruct the light.

The "hulls" are provided with fires for drying the blades after they have been ground; but the fireplaces are as a rule situated either in the front or in one of the lateral walls, and consequently their utility as ventilating agents is largely reduced. Each "hull" contains one, two, or more troughs which run from front to back, and in them are placed the grinding, glazing, and polishing wheels, in the order in which I have mentioned them. The floors are wet and dirty, and the atmosphere of the rooms damp and stagnant, particularly at the back where it is further defiled by dust given off from the polishing wheels. The cubical space per worker would as a rule be ample if sufficient ventilation were maintained.

Dry grinding and the lighter branches of wet grinding are carried on in rooms in the upper stories. Articles which are partly dry and partly wet ground are also as a rule ground in these rooms. Better ventilation exists here, but on the other hand the rooms are often overcrowded, and where dry grinding is done there is much dust generated. In the majority of dry grinding rooms an effort is made to remove the dust by fans, but occasionally these are absent. One fan is as a rule sufficient for several workmen. Attached to it are a number of tubes, each of which ends in an expansion or hood in front of the grinding stone. The tubes are put down by the owner of the factory, who likewise occasionally supplies the fans; but as a rule the fans and hoods belong to the workmen.

When properly constructed and looked after the fans act admirably for removing dust, and also aid in ventilating the workshops; but as several workmen commonly occupy one room and share responsibility for its sanitary condition, there is the usual failure to perform efficiently that which is the duty of no one in particular. For this reason the tubes are apt to become choked from not being periodically cleaned out, or a trivial defect, which a few minutes would remedy, is allowed to render the fan inoperative for days together. Again a careless grinder by neglecting to use a hood will seriously discount the effort of his more careful shopmates to keep down dust.

Hence it happens that in many workshops where dry grinding is done, the dust accumulates in large quantities on the floor, to rise in dense clouds each time it is disturbed.

The buildings in which cutlers work vary very widely in their sanitary aspects. Many of these places are as perfect as it is possible to make them, having regard to the nature of the work carried on therein. The rooms are lofty, well lighted, and provided with efficient means for ventilation, together with fans for the removal of dust where such is generated in large amount. But in the manufacture of scale tang cutlery where glazers are extensively used the atmosphere, under the most favourable circumstances, is charged with fine dust. This is especially noticeable where bone is employed for hafting. Moreover, manufacturers complain bitterly that the workmen will often block up ventilators and dispense with the use of fans unless strict vigilance is maintained. It may appear to be incredible that anyone should pursue so suicidal a policy, yet personal observation compels me to admit that these allegations are not altogether groundless.

But while I gladly note these superior factories, I am compelled to state that in a large number of cutlery works the sanitary conditions are utterly bad.

Dilapidated buildings, constructed in the first instance without due regard to the requirements of health, are sadly too common. In these, overcrowding, defective ventilation, and a dust laden atmosphere are the rule rather than the exception. Externally the condition of affairs is often no better, the factories being shut in by other buildings which exclude sunlight from the lower rooms, and interfere with the circulation of the air.

Fans exist in the majority of scale tang cutlers' shops, but by no means in all. When present they are sometimes useless owing to the choked condition of the outlet tubes. Another grave defect is the indiscriminate mixing of various classes of workers. Thus in a shop where a dozen men work, only two or three may be engaged in dust-producing processes, yet all are obliged to inhale the dust laden atmosphere.

Again a careful workman will provide a fan for his own use and still suffer from dust, because his shopmates work without fans. Such instances are perhaps rare, but they serve to emphasise the difficulties that arise in dealing with the sanitary evils of the trade.

The forging, grinding, and hardening of files are conducted on the premises of the manufacturer; but file cutting by hand, which gives employment to more than one-half of all file makers, is usually done by outworkers in shops which they rent for their use. These workshops are commonly one storied buildings, situated in courts and yards, and surrounded by dwelling houses. Many of them are in close proximity to middens, which receive the excreta of the surrounding inhabi-

tants, and are nearly always wet and offensive. Occasionally the file cutters' shop is placed under the same roof with a midden, being separated from it only by a thin brick wall.

The workshops contain from two to ten or more workers, and are nearly always overcrowded—often much overcrowded.

I measured 21 workshops, in which 109 file cutters worked, and found the average space to be equal to 167 cubic feet per worker, and in one instance it was as little as 100 cubic feet. It should be added that these shops were not specially selected, and are probably a fair sample of what obtains throughout the older parts of the city. It is exceptional to meet with any special means for ventilation; and as the occupation is a sedentary one, the windows and doors are shut during cold weather.

Fortunately all file cutters' shops are provided with a fire, but as the chimney is always a low one, its aspirating effect is inconsiderable. Moreover, the faces of the workers are on a higher level than the chimney throat, and consequently the conditions for using it as a ventilator are bad. Occasionally one meets with a rude arrangement for washing the hands, but this is so exceptional as to be remarkable.

I shall now place before you the information which statistical returns afford us respecting the incidence of disease and death on these workmen.

Unfortunately, the trade societies to which the workmen belong exist only for the purposes of regulating prices, and of providing pay for them when they are out of work, or on strike; nor do the sick and funeral clubs furnish data sufficiently exact to be of any value for this purpose. The only significant fact I have been able to gather from this source is that most sick clubs decline to admit to membership dry grinders on the plea of their unhealthy calling.

But while we are cut off from the information which a well organised system of registration of sickness would afford, the registrars' death returns provide us with material from which it is possible to extract data showing the influence of occupations on the health and length of years of workmen.

Until quite recently in this country, if we except the valuable decennial reports of the Registrar-General, the task of working out mortality tables bearing on trades has been shamefully neglected, and yet I can conceive of no more useful work to which Medical Officers of Health could turn their attention; and I would respectfully and earnestly suggest to the Local Government Board the expediency of insisting on such tables being supplied for the chief trade centres in the country.

Following the example set by Dr. Ogle and his illustrious

predecessor Dr. Wm. Farr, I began in 1885 to compile the death returns for the more important trades of Sheffield. The work has been continued by my successors at the Sheffield Health Office, and through the kindness and generosity of Dr. H. Littlejohn, the present Medical Officer of Health, I am able to present to you mortality tables for grinders and file-makers which are perhaps unique.

An examination of death returns may be made to yield useful information in a variety of ways. By comparing the number of workmen in each trade, who have died during a stated period, with the computed number engaged in each trade, we ascertain the death-rate prevailing among workmen in various trades for that period. [Before this method can however be made generally applicable, the census returns will require to be much more detailed than heretofore. Thus at present the census returns give no information whatever respecting the number of grinders in the country, these workmen being classed with other trades.] By tabulating the deaths in each trade according to the diseases which occasioned death, we ascertain to what diseases workmen in any particular calling are specially liable. And lastly, by making a classification in which the age at death is the leading feature, we are able to indicate the length of life attained by workmen in various trades.

For the purpose of publication I have compiled mortality tables showing the number of deaths, the principal diseases which caused death, and the age at which death occurred among grinders and file-makers in Sheffield during the eight years 1885—92. Deaths among females, and boys under the age of 15 years have been excluded.

To make the figures readily intelligible to the ordinary reader, I have added a comparative mortality column compiled from the annual reports of the Registrar-General for the years 1887-88-89. This column shows the proportion of persons who died of various diseases at various age periods per 1000 deaths among the entire male population of England and Wales over the age of 15 years. It will afford at a glance the means of comparing the incidence of disease and death on the workmen I have mentioned with that obtaining among the entire adult male population of the country. The critical reader may observe a few minor inconsistencies, which are unavoidable owing to the smallness of some of the numbers dealt with.

For many reasons the mortality prevailing among the entire adult male population is the most convenient standard by which to compare that for various occupations; but as Dr. Ogle has pointed out it is not an ideal standard, because "it is contributed to by an enormous number of persons who are permanently

enfeebled in health, and unfit for work of any kind;" and other things being equal, should be higher than the mortality among a body of workmen such as grinders, the majority of whom are healthy and robust when they begin their trade.

I will now briefly point out the most important facts brought to light by these tables. The most significant of these in connexion with grinders is the appalling death-rate which obtains among them from phthisis and other diseases of the respiratory organs. Phthisis causes 345, and other respiratory diseases 295, in every 1000 deaths among grinders, as compared with 144 and 182 in every 1000 among the entire male adult population of the country. In other words, these diseases are more than twice as fatal to grinders as they are to the entire male adults of the country. If we turn to the ages at death, a similar unsatisfactory state of things prevails. 458 grinders in every 1000 die between the ages of 35 and 55 years, as compared with 261 for the entire adult male community; and only 140 deaths in every 1000 occur after the age of 64 years, as compared with 391 in every 1000 for the entire adult male community.

The dusty nature of a dry grinder's occupation prepares us to accept these figures as applied to him; but it must not be lost sight of that dry grinders form a very small minority of the grinding trade, probably less than five per cent. of the entire number. Moreover, my investigations lead me to believe that dry grinders, although they still show an enormous mortality from phthisis and bronchitis, live to a much greater age than formerly. Thus I found the average age of twenty-two unselected fork grinders to be forty-three years, which is a marked improvement compared with the late Dr. Hall's estimate of twenty-nine years. Again, during the four years 1889—92, the average age at which fork grinders died was $45\frac{1}{2}$ years. It is quite evident, therefore, that dry grinding will not account for more than a small proportion of the excessive mortality which prevails among grinders as a class.

If we except the processes of "polishing" and "racing the stones" wet grinders produce very little dust, but they have an equally potent agent for mischief in the damp, ill-ventilated atmosphere in which they work; and to this cause may be attributed their excessive fatality from pulmonary diseases.

The mortality column for file makers shows that 453 in every 1,000 deaths occur between the ages of thirty-five and fifty-five years, as compared with 261 for all adult males, and that only 198 in every 1,000 take place after the age of sixty-four years, as compared with 391 for all adult males.

The diseases which occasion the excessive mortality among file makers are phthisis and other respiratory disorders, which

DISEASES.	AGES AT DEATH.	Deaths registered in Sheffield during the eight years 1885-92.		Proportion of deaths per 1000 due to various diseases at various age periods during the eight years 1885-92.		Comparative Mortality Column, shewing in each 1,000 deaths of Males in England and Wales over age of 15 years, the number caused by various diseases at various age periods during the three years, 1887-88-89.
		GRINDERS.	FILE MAKERS.	GRINDERS.	FILE MAKERS.	
Diseases of the Nervous System.	Under 25 years	1	1	1	1	6
	25 and ,, 35 ,,	3	3	3	4	7
	35 ,, ,, 45 ,,	9	26	11	36	12
	45 ,, ,, 55 ,,	15	18	18	26	17
	55 ,, ,, 65 ,,	12	28	14	39	26
	65 and over	17	25	20	35	61
	All ages	57	101	67	141	129
Diseases of the Respiratory System.	Under 25 years	10	6	12	9	7
	25 and ,, 35 ,,	29	12	34	17	12
	35 ,, ,, 45 ,,	35	27	41	38	19
	45 ,, ,, 55 ,,	65	44	76	61	28
	55 ,, ,, 65 ,,	67	37	79	51	40
	65 and over	45	47	53	66	76
	All ages	251	173	295	242	182
Phthisis.	Under 25 years	26	19	31	26	28
	25 and ,, 35 ,,	41	28	49	39	37
	35 ,, ,, 45 ,,	81	42	95	59	34
	45 ,, ,, 55 ,,	86	31	101	43	25
	55 ,, ,, 65 ,,	47	14	55	20	14
	65 and over	12	1	14	1	6
	All ages	293	135	345	188	144
Diseases of the Urinary System.	Under 25 years	2	0	2	0	2
	25 and ,, 35 ,,	3	9	4	12	3
	35 ,, ,, 45 ,,	1	14	1	19	5
	45 ,, ,, 55 ,,	9	15	11	21	7
	55 ,, ,, 65 ,,	5	9	6	12	10
	65 and over	1	4	1	6	18
	All ages	21	51	25	70	45
Diseases of the Circulatory System.	Under 25 years	3	2	3	3	6
	25 and ,, 35 ,,	7	9	8	13	8
	35 ,, ,, 45 ,,	12	15	14	21	14
	45 ,, ,, 55 ,,	14	16	17	22	21
	55 ,, ,, 65 ,,	16	15	19	21	31
	65 and over	11	11	13	15	63
	All ages	63	68	74	95	143
Diseases of the Digestive System, including Liver.	Under 25 years	5	2	6	3	4
	25 and ,, 35 ,,	6	3	7	4	4
	35 ,, ,, 45 ,,	3	5	3	7	7
	45 ,, ,, 55 ,,	3	7	3	10	11
	55 ,, ,, 65 ,,	4	7	5	10	13
	65 and over	3	1	4	1	19
	All ages	24	25	28	35	58
All other Diseases.	Under 25 years	15	12	18	17	28
	25 and ,, 35 ,,	17	17	20	24	24
	35 ,, ,, 45 ,,	27	33	32	46	29
	45 ,, ,, 55 ,,	30	32	35	44	32
	55 ,, ,, 65 ,,	22	17	26	24	38
	65 and over	30	53	35	74	148
	All ages	141	164	166	229	299
All Causes.	Under 25 years	62	42	73	59	81
	25 and ,, 35 ,,	106	81	125	113	95
	35 ,, ,, 45 ,,	168	162	197	226	120
	45 ,, ,, 55 ,,	222	163	261	227	141
	55 ,, ,, 65 ,,	173	127	204	177	172
	65 and over	119	142	140	198	391
	All ages	850	717	1000	1000	1000

cause 43 per cent. of all deaths, as compared with 32·6 per cent. for all adult males; urinary diseases 7 per cent., as compared with 4·5; and nervous diseases 14·1 per cent., as compared with 12·9.

The Registrar-General's estimate for file-makers, although compiled on a somewhat different plan from that which I have adopted, shows similar results. His general mortality figure for these workmen is 1,667, as compared with 1,000 for all males at corresponding age periods, while his special mortality figure for phthisis and other diseases of the respiratory organs is for file-makers 783, as compared with 402 for all males. Moreover, he shows that the mortality from lead poisoning among file cutters is more than twice as great as that among any other class of workmen.

The deaths registered as being actually due to lead poisoning, together with the excessive mortality from diseases of the urinary and nervous systems, may be properly referred to the lead bed used by file cutters; while the abnormal mortality from phthisis and other respiratory diseases is accounted for chiefly by the overcrowded and badly ventilated workshops n which they work.

Had it been possible to compile a mortality column for file cutters only, there can hardly be a doubt that it would have shown a higher mortality still.

Owing to the ambiguity which exists respecting what constitutes a cutler, the Registrar's returns for this trade are comparatively worthless, and I have been unable to compile a trustworthy mortality table for these workmen; but there can be little doubt that scale tang cutlers suffer greatly from diseases of the lungs.

The Registrar-General's estimate for this class of workmen shows a general mortality figure of 1309, and a special mortality figure for phthisis and other respiratory disorders of 760, as compared with 1,000 and 402 respectively for all males at corresponding age periods.

But before accepting the figures I have prepared as showing the unhealthy nature of the callings pursued by these workmen, it is desirable to enquire if there are other factors than their occupations which may specially influence their health for good or for evil. In other words, do their habits of life and the conditions under which they live outside their workshops materially contribute towards the results which statistical evidences yield? This is an exceedingly complex question, and yet on its solution depends the value to be attached to statistics when they are offered as evidence of the unhealthiness or otherwise of any trade. A calling may of itself be a healthy

one, and still show an excessive mortality among its workers owing to their dissipated habits. The same result may accrue owing to the workmen spending their nights and unoccupied hours in unsanitary houses, or in districts that are from their position unhealthy. On the other hand the incidence of unhealthy trades will be less felt by workmen who live prudent lives under favourable hygienic conditions when not at work, than by others less prudent or less favourably situated.

Briefly it may be taken that the habits of life and the houses occupied by the workmen I am discussing are, from a sanitary point of view, neither better nor worse than what obtains among the other artisan classes in Sheffield. There are no data which would enable us to form an accurate estimate of the mortality prevailing among this class, and the most we can do is to fall back on the evidence afforded by the mortality figures for the entire city.

Without wearying you with tedious details, it may be stated generally that the average death-rate for Sheffield is somewhat higher than the average for the other large towns in England, and distinctly higher than that for the entire population of the country.

We must therefore remember that, in comparing for the purpose of my lecture the mortality prevailing among Sheffield workmen with that for the entire country, the Sheffielder starts somewhat handicapped. A part of this handicap, it is true, is the result of unhealthy trade influences and should not count, but the greater portion is undoubtedly the outcome of other causes. The total amount however is not sufficient to seriously influence the results arrived at, and if we take the mortality among all adult males in Sheffield as our standard, it will still be found that the trades under review are distinctly unhealthy according to this standard. Thus the death-rate for all males over the age of fifteen years in Sheffield during the eight years 1885—92 was 19·1 per 1000 per annum, while that for file makers during the same period and at corresponding age periods was 22·1 per 1000 per annum.

Owing to defects in the census returns it is impossible to calculate the annual death-rate for grinders, but it is quite certain that it also is largely in excess of that for all adult males in Sheffield.

The legislature of this country has done much to improve the conditions under which workmen pursue their various callings, and although local peculiarities and unforeseen contingencies sometimes frustrate the beneficent intentions of our legislators, there can be no doubt that the Factory Acts have been and will continue to be productive of an enormous amount of good.

The most important portions of these Acts, from a sanitary point of view as applied to the trades I am dealing with, are Clauses 3 and 36 of the Factory Act of 1878, and Clause 8 of the Act of 1891.

The first of these enacts that "a factory shall not be so overcrowded while work is carried on therein as to be dangerous or injurious to the health of persons employed therein, and shall be ventilated in such a manner as to render harmless, so far as practicable, all gases, vapours, dust, or other impurities generated in the course of the manufacturing process or handicraft carried on therein that may be injurious to health." The second provides that "If in a factory or workshop where grinding, glazing, or polishing on a wheel, or any process is carried on by which dust is generated and inhaled by the workers to an injurious extent, it appears to an inspector that such inhalation could be to a great extent prevented by the use of a fan or other mechanical means, the inspector may direct a fan or other mechanical means of a proper construction for preventing such inhalation to be provided within a reasonable time."

The third clause provides that when the Secretary of State certifies that any trade is dangerous or injurious to health, the Chief Inspector may serve on the occupier of the factory or workshop a notice requiring the observance of such special rules, or the adoption of such special measures, as appear to the Chief Inspector to be reasonably practicable, and to meet the necessities of the case.

The Acts further stipulate that the occupier shall be responsible for carrying out the various provisions which they contain.

At first sight it would appear that these enactments leave nothing to be desired, but when we examine their application to the cutlery trades it is found that they work badly, owing to the difficulty of bringing home responsibility for their observance.

Commander Hamilton Smith, Factory Inspector for Sheffield and the surrounding districts, has been good enough to give me his views on this and other defects in the Factory Acts. He points out that "many grinding wheels and cutlery works are the property of companies who let off rooms and power to workmen, and successfully repudiate responsibility for sanitary control." It would appear that the same irresponsibility can be claimed by cutlery manufacturers who let rooms or parts of rooms to their own workmen; and that if the Inspector insists on fans or other needful appliances being provided, he must proceed legally against the workmen.

The outcome of all this is that it is difficult or impossible to

apportion responsibility for sanitary requirements, the Inspector's work is enormously increased, and often rendered excessively irksome, while the amount of good he can effect is proportionately lessened.

There is but one remedy for this state of things. Sooner or later the Legislature will have to fix on the individual who lets off rooms and power to workmen the responsibility for carrying out the provisions of the Factory Acts. We shall be told that an enactment of this kind would disturb long established trade usages, and be unfair to the manufacturer; but apart from the fact that it is the only feasible way out of the difficulty, it would merely place cutlery manufacturers on the same footing as that occupied by most other employers of labour in the country. Moreover, some of the best cutlery firms already recognise their moral responsibility in this respect, and provide for the use of their workmen fans and all other contrivances of a sanitary nature.

The Factory Act of 1891 transferred the sanitary control of workshops from the Factory Inspector to the Local Authority. Under its provisions all new workshops must be registered, and a register of such places is kept by the Medical Officer of Health. The period which has elapsed since the passing of this Act is not sufficiently long to enable one to pronounce final judgment on its working, but at least one defect has already come to light. The Act did not make it obligatory on the part of the Local Authority to provide efficient machinery for the proper supervision of these places, and the Sheffield Local Authority have not availed themselves of the optional power they possess in this respect, but have handed on to the already overworked Sanitary Inspectors the duty of inspecting workshops. Up till the present time there has been no systematic inspection of these places, nor has any serious attempt been made to deal with the overcrowding and other sanitary defects which abound in them.

It is calculated that there are altogether 2,000 workshops in Sheffield, and to efficiently control these at least three special inspectors should be provided.

The law at present stipulates that the occupier of a workshop shall within one month of the date of commencing to use such workshop notify the fact to the inspector, and supply him with details respecting the nature of the work, &c., carried on therein. This requirement is so far so good, but it does not go far enough. It would be much better if the legislature insisted on inspection and approval as preliminaries to the registration or licensing of premises as workshops.

In this way, as Commander Hamilton Smith points out, "no

license would be granted for undesirable places, the license would state exactly the conditions required. The occupier and landlord knowing what to do would do it; and when it was found necessary to prosecute, the inspector would present to the Bench an actual offence, instead of what is now considered the technical offence of not having given notice of occupation."

Having regard to the unhealthy character of the work done by grinders, file cutters, and certain classes of cutlers, the Home Secretary should direct the Chief Inspector of Factories to draw up special rules under Clause 8 of the 1891 Act, containing requirements to be observed in places where these trades are carried on. The rules should specify the minimum cubical space per worker permissible, together with the special means to be provided in each case for the removal of dust and impure air.

A notice should be exhibited in each room showing its cubical capacity and the maximum number of workers who may be employed therein at any one time, together with the special rules to be observed. Before however special rules can be made effective, it will be necessary to shift the responsibility for their observance from the workmen to the person who lets off the rooms.

The sanitary condition of rooms in which grinders, particularly wet grinders, work admits of much improvement. These rooms should always be above the level of the surrounding ground, and so situated in regard to surrounding buildings as to allow of free entrance for fresh air and sunlight. The floors should slope to the front, and be composed of concrete or some other impermeable material so that it would be impossible for pools of water to collect, as is frequently the case at present. Better means for ventilation are urgently required, especially for the back part of the rooms. The fire-places might with advantage be placed at the back, so as to secure a thorough current of air. Another excellent plan would be to have an exhaust fan for each room connected with a series of tubes ending in front of the polishing wheels. In this way a thorough current of air from front to back would be secured, while the tubes would carry away the dust generated in polishing.

To minimise the danger arising from the breaking of grinding stones it should be obligatory to use plates and bolts instead of wedges for fastening the stones on their axles.

Dry grinding should be done in separate rooms, and not as is sometimes the case in the same room where wet grinding is carried on. When stones are being "raced" the workmen should use some form of respirator. In the absence of a special appliance an ordinary woollen muffler drawn over the mouth and nose answers very well.

In cutlers' shops there ought to be ample air space, and the means for ventilation should, as a rule, be beyond the control of the workmen. The glazing wheels used by scale tang cutlers should always be provided with fans for carrying away the dust. Fans might likewise be extended to other dusty processes with advantage, as in addition to removing dust they are very efficient ventilators. Where practicable dusty and non-dusty processes should be carried on in different rooms.

Where file hardners use a lead bath, there should always be a flue for carrying away the fumes given off from the bath. Apart altogether from the possibility of these baths giving off the vapour of lead, flues are required for the removal of other noxious gases.

Bearing in mind the poisonous nature of a file cutter's trade, ample air space should be insisted on—not less than 300 cubic feet per worker; and this should be conjoined with suitable means for ventilating the workshops.

File cutters' shops that are placed in close proximity to foul middens, or so surrounded by buildings that ingress of fresh air and sunshine are impossible, should be closed as unfit for habitation.

A lavatory with water, soap, and nail brushes, should be provided for washing the hands after work, and workmen should be discouraged from eating or storing their food in the workshops.

I need hardly say that attention has been repeatedly directed to finding a substitute for the lead bed on which the files are cut. Unfortunately the peculiar physical properties of lead, which render it so suitable for this purpose, are not met with in any other non-poisonous metal or alloy. After having devoted much time to this point, and having had trials made of nearly every substance which appeared likely to answer the purpose, and after calling in the aid of several experts, I can only confirm the opinion formed by previous enquirers that there is no known substance other than lead, or an alloy of lead, that will meet the requirements of the file cutter.

But while we are unable to suggest a substitute for the lead bed, there can be no doubt that its evils may be to a large extent prevented by adopting well recognised precautions. The most important of these are, to wash the hands and moustache before eating, to frequently remove all the dust that has collected around the anvil, and to avoid as much as possible contact of the left hand with the lead. The lead block should be made as narrow as possible, and a strip of clean paper might be placed over that part of it which comes in contact with the hand.

In conclusion, let me impress on you the supreme importance

of trade sanitation. It has its sentimental side, but in this eminently practical age the value of sentiment is apt to count for little. We cannot however afford to ignore the practical bearings of the subject. Each skilled artisan represents a certain amount of wealth to the nation, and his premature death or disablement from preventible causes is a direct and unnecessary loss to the country, while indirectly it leads to the same result by swelling the burden of providing out of the public purse for those who are dependent on his labour for sustenance.

Strangers from other lands when they come to this country are much impressed with the manner in which we care for the sick, the destitute, the demented, and even the felon. Let it be our aim to make the sanitary condition of our factories and workshops also a source of national pride, and in accomplishing this we shall not only add to our wealth, but likewise brighten and better the lot of our toiling fellow countrymen, who are the life blood of the nation, and who have done so much to make England the workshop of the world.

TEXTILE MANUFACTURES, SILK, COTTON, WOOLLEN AND LINEN INDUSTRIES.

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It was at rather a late period before the date fixed for this Lecture that I had the honour of being asked by the Council of the Institute to undertake the subject of the Sanitation of Textile Industries. I solicit therefore some indulgence on the part of my audience when they come critically to examine the facts and opinions I advance. These, I may say, are for the most part the fruit of my own observations made in textile factories in different parts of the country. At the same time they have the disadvantage of being the observations of one who professes to be no expert in textile operations, or in the comprehension of the intricacies of the most complicated and elaborate machinery therein employed.

Happily I do not feel called upon to describe that machinery, and need only refer to it in its relations to sanitation and to the materials submitted to its operation.

Of the textile manufactures, it may be safely stated that they rank first among the industries of this kingdom, by the number of persons engaged in them, and by the value of their products. They were also the first to assume a national importance, and to elevate this country to its pre-eminent rank as a manufacturing one.

Moreover, from their rise and development, and from the outcome of sanitary, social, and moral conditions, they were the first to call into existence factory legislation and the intervention of the State in the conduct of private enterprise; the first, in short, to make an inroad upon the principle of individualism.

The extent of the textile industries is a well-known fact. It

will render it still better understood if I quote figures from the last Return of the number of textile factories, and of that of the persons employed in them, made to the House of Commons in 1890. From this document it appears there were 7,190 such factories in Great Britain and Ireland, together employing 1,084,631 individuals. Of these 428,082 were males, and 656,549 females. A further analysis of the Return shows that of these 86,499 were working half time, and consisted of 40,558 males and 45,941 females. Owing to comparative stagnation of trade in textiles since 1890, I fancy these figures about represent the numbers of the employed at the present day.

A glance at the statistics shows at once that the textile industries give employment to many more women than men, the former exceeding the latter by nearly 230,000, which number is little short of one-fourth of the total of the employed.

The transition from hand-spinning and hand-weaving (due to the introduction of steam-power) to machine-spinning and weaving, was very rapid, and its immediate consequence was the origin of associated labour on a scale hitherto unknown, and a development of trade theretofore undreamt of. From this flowed remarkable changes in the social conditions, and in the distribution of the industrial population; and co-ordinate changes charged with important sanitary consequences.

But it remains a remarkable fact that those consequences of employmeut upon health have attracted very little attention from the medical profession. For excepting stray communications in medical periodicals, the almost only source of information respecting the hygiene of textile factories is to be found in the "Blue books" issued by the medical staff of the "Local Government Board," and of the medical department of the Privy Council Office that preceded.

Of all official writers on the diseases and mortality of textile operatives, we are most indebted to the late Dr. Headlam Greenhow, who acted under the direction and supervision of Sir John Simon.

What especially is still needed are careful clinical observations on the disorders of textile workers, and minute investigation of the lesions associated with them; not omitting a concurrent judicious examination of the sanitary conditions of the labour pursued.

In no country in the world are larger and better opportunities for such study to be found than in the United Kingdom; and I hope to arouse the attention of medical practitioners in textile towns to the subject, and to the wide field it opens out for original research.

The *textile industries* are divisible into several branches according to the material used. Such are the silk, cotton, woollen, linen, and jute and hemp manufactures. Subordinate branches are represented by carpet-making, lace-making, and hosiery-making, by blanket and flock-making, by the weaving of cocoanut fibre, and by the making of cordage and of horse-hair tissue.

The mere enumeration of textile trades suffices of itself to show that the materials employed have very diverse origin; some coming from the animal and others from the vegetable kingdom. Indeed, the list would be incomplete were the mineral kingdom forgotten, seeing that asbestos is a substance that can be woven into a tissue.

The textile materials derived from the animal kingdom are silk, wool and its congeners, mohair and cashmere, and horse-hair. Those coming from the vegetable kingdom are cotton, flax, jute and hemp, and cocoanut fibre and straw. There are indeed other fibrous substances brought into use for weaving materials suitable for clothing and other purposes; but of them no account is called for in the present lecture on the textile industries of Great Britain.

The various manufactured products of these several substances differ widely in economical importance and commercial value. Likewise the manufacturing processes and machinery concerned in elaborating them, differ among themseves in character and in various incidental and accidental features; add to these the distribution of the sexes and of the ages of the workers engaged in them. Yet amid all the diversities obtaining between the several forms of textile industry, these have certain features in common. The most marked are the processes required for spinning the material into "yarn" and its subsequent weaving into "cloth."

The machinery employed in all textile works presents a general similitude in principle, although it differs in detail according to the material dealt with, and the form of tissue to be evolved from it. Moreover, it is perpetually undergoing modifications aiming at greater simplicity or efficiency, or at greater cheapness of production.

Again, noise and vibration are inseparable from machinery, and must operate as sanitary factors not to be ignored.

Further, machinery moved by steam or other power, collected within a common building, and having its purposes directed to various ends, implies associated labour. Also in certain measure, although common employment prevails, the intricate working of machines leads to a great sub-division of labour, and along with this a remarkable monotony of work.

Its speed likewise demands unremitting attention, and causes strain upon the organs of sense.

Another incident attaching to many machines is, that they entail a standing, and often too a bent position, or it may be a greater weight or strain upon one part of the body than on another, leading to distortion; others again involve a sitting posture with its drawbacks to health.

Yet another widely prevailing incident is the production of dust by machines in connection with the material operated upon. In this matter we recognise a most important health factor; one, in fact, occupying the foremost place in textile work at large.

What the amount of dust diffused shall be, is mainly determined by the physical nature of the substance acted upon, and the possibility of guarding against the evolution of dust by mechanical means. Again, machinery though universal in textile trades, has to be modified by special arrangements in some of them, for the supply of moisture, or steam, or oil, and to these substances its consequences to health are attributable in no small degree.

Such, in general terms, are the sanitary incidents accompanying the use of machinery, and to be found in varying degree in textile works at large.

A description of the machinery in use for spinning and weaving I am not competent to give. To attempt it, one would require the technical knowledge of a mechanical engineer, and if accomplished, few of my audience would derive instruction therefrom.

In fact, it is not a little embarrassing to comprehend and bear in mind the special appellations given to particular divisions of labour and to those who follow them; for these differ in different textile occupations and in different localities. Besides, such special knowledge is not necessary for the understanding of sanitary conditions.

Another circumstance not to be overlooked is, that the complicated machinery of textile factories is fraught with danger to life and limb; and this peril is far too frequently exemplified. Considering, however, the thousands of rapidly revolving wheels in machine-rooms, and the array of shuttles in the weaving sheds, the extent of "shafting," and the multitude of "belts" twirling in all directions, the marvel is that many more accidents do not happen; and the more so, as a very considerable proportion of the hands employed are young persons and children, among whom care and caution are not common characteristics. Injuries to hands and fingers from being pinched between wheels, or pricked by sharp points, are frequent; whilst

now and again a female worker is caught by her hair by a belt, or her loose dress gets entangled between wheels, and a serious accident is the consequence.

There is, moreover, a special kind of accident connected with looms, arising from the detatchment and flying off, with almost electric speed, of "shuttles." When this happens, owing to the elevated position of the shuttle, the usual disaster is the destruction of an eye. The ingenuity of mechanicians has greatly reduced this accident in frequency, but not extinguished it.

On this matter of accidents, it is painful to state that many of them are due to the carelessness of the artisans themselves.

Other sanitary factors common to the textile trades are sedentary labour, heat of workrooms, neglect of ventilation, re-breathed air, unnecessary consumption of gas, and, as before noticed, monotony of work and constrained posture of the body.

These conditions may be termed incidental; but over and above them are many others truly accidental, and for the most part attaching to the workers themselves and in a very large measure avoidable; such are, the neglect of proper clothing, unnecessary exposure to cold by passing from heated rooms into the outer air, improper food, irregular living, dissipation and unhealthy homes. All such insanitary conditions are too well known to need enlarging upon in a lecture devoted to a particular group of manufactures. I now come to the consideration of the *diversities* which exist between the processes of manufacture of the several textile materials. These are far more numerous and of more importance hygienically than their characters in common.

They chiefly have their origin in the physical characters of the materials used, and of the dust evolved from them. Viewed in ascending order from the least injurious we have, silk, wool, cotton, flax, jute, and hemp.

Again, the nature of the material regulates that of the processes pursued in its manufacture, as well as the kind of machinery requisite.

Bearing in mind what a textile tissue is, it is evident that it must be constructed of animal or vegetable fibres, intertwisted and interlaced more or less minutely; and as a further requirement, that those fibres shall be capable of resisting tension, torsion, and twisting without fracture. These qualities exist in very varying degrees in the different materials employed, and even in various specimens of the same textile substance.

When subjected to the microscope, the intrinsic structure of the fibres of the several materials is seen to differ widely. Thus, the fibres of silk are recognised by their unbroken con-

tinuity, their soft outline, and the absence of a central cavity, and when in masses, by their extreme softness and flexibility. Those of cotton exhibit a harder outline and a hollow interior.

Again, those of wool presents a still harder outline, and like common hair, have a figured variegated surface, and are really hollowed cylinders.

Lastly, the fibres of linen have a firmer appearance than those of cotton, are less tubular in aspect, and marked at distances by transverse septa. They likewise fracture more readily, the broken ends being frayed.

These structural peculiarities necessarily infer a different adaptability of the fibres to the processes of spinning and weaving—an inference the truth of which experience amply demonstrates.

It is above all in the first or preparatory operations on the raw material, that the greatest differences in connection with sanitation between the several textile substances exist, and that the most serious conditions adverse to health are met with.

To properly illustrate this fact, it is necessary to take each kind of textile substance in turn; though I shall omit horsehair, cocoanut fibre, and asbestos as of inconsiderable importance in comparison with the rest.

1. *Sanitation of the Silk Manufacture.*—Beginning with silk, there are several qualities of this article, each of which requires a somewhat different method of preparation before it reaches the spinning machines. The trade distinguishes between silk, and silk waste. The best qualities of the former come from China and Italy in a nearly fit state for immediate use.

Reeling from the cocoons immersed in warm water is the primary business. After this follows the cleansing of the fibres from a gummy matter that invests them, by means of boiling in an alkaline solution. In the case of silk waste, these preliminary operations are attended by a nauseating smell. In the next stage wherein the entangled mass is torn apart in cylinders armed internally with steel teeth, a great amount of dust is produced; but happily is rendered of small account by the operation being conducted within an enclosed box or case.

A carding or combing process also performed in enclosed machines next follows, whereby particles of dirt that have escaped previous operations are removed, and a clean bright silk turned out ready for immediate spinning.

But notwithstanding that the operations concerned in manufacturing silk are, at the present day, little chargeable with ill consequences to the health of the operatives, it was not so some years since when, in 1861, Dr. Headlam Greenhow made a special investigation of the causes and prevalence of chest

diseases and consumption in the manufacturing towns of the kingdom. At that date the mortality of silk workers from those maladies exceeded that of most other artisans; whilst various bodily deformities prevailed, due to unhealthy modes of working.

Indeed, the entire sanitary history of the silk manufacture goes to show that its unhealthiness followed largely from preventible causes, and that its former high ratio of sickness and mortality was less attributable to the actual processes of the trade than to accidental conditions of labour—a group of health-destroying agents by no means peculiar to the silk trade, but pervading formerly every textile manufacture. These agencies are now greatly reduced in number and intensity, mainly by the sanitary provisions of the Factory Act, which protect children from too early and laborious work, curtail and regulate the labour of all hands, young and old, directly and indirectly, and successfully further better hygienic conditions in the case of all factories and workshops. Co-operating with the Factory Laws in accomplishing the like salutary ends, has been the advance on the part of the public of a superior knowledge of sanitary science, the improvement of the homes of the working classes, and the better provision made for their out-door amusements, and for their intellectual and moral advancement.

But if these avoidable incidents of the silk manufacture are to a great extent removed, one of the unavoidable kind persists, viz., the sedentary nature of the work, and it is one unfortunately of very destructive energy.

Moreover, as things stand, another injurious incident remains in action, though greatly reduced in degree, I refer to the dust generated in some processes, and to which the prevalence of bronchitis and asthma must be assigned, together with the comparatively shortened duration of life noted among silk workers.

Nevertheless, when everything is taken into consideration we cannot fail to recognise an improvement all round in hygienic conditions, and are entitled to anticipate ever advancing progress in the sanitation of our industries.

2. *The Sanitation of the Cotton Manufacture.*—Turning next to cotton; there are many commercial varieties of that product, the differences between which are due chiefly to the length, tenuity, and strength of the fibres, and the more or less dirty state in which cotton is sent into the market. Here again, from a hygienic point of view, it is, for the most part, in the preparatory processes that circumstances obnoxious to health are to be found.

The opening out of the bales and the sorting of the cotton as it first comes to hand, is a dusty business. So likewise is the ensuing one. This consists in freeing the cotton from seeds and accidental foreign particles by the aid of scutching machines, which tear apart the mass and beat out the dirt, before it reaches the blowing apparatus and passes onward to the carding machine. The combing action of the latter finally cleanses it from all extraneous substances, and delivers it in a filmy cord-like shape called a "sliver," for the further action of the elaborate apparatus of the machine shop for its conversion into yarn. The earliest stages of sorting, mixing, and scutching are the special occupation of women, who suffer from the dust and "flue" thrown off in those operations, and become the most frequent victims of the peculiar bronchitis and asthma of cotton workers.

The amount of dust, and its greater or less irritating effects on the breathing organs, depend upon the quality of the cotton, being greater in the case of the inferior brands.

Within a brief period the steel teeth of the carding machine become blunted and choked with refuse cotton. Hence it is requisite to clean and sharpen them. This business is the work of a special class of men known as "strippers" and "grinders"—a class particularly subjected by their work to the inhalation of dust, and among whom a high ratio of chest disease prevails. To remedy the disasters, ingenious self-cleaning and sharpening machinery has been invented, and been attended by considerable success.

In olden time the carding machines were worked without enclosing boxes, and therefore with sad results to the operatives by reason of the vast quantity of dust they threw off. Their enclosure put an end to this evil.

In the several stages of spinning the yarn little dust is encountered, though in the after operation of winding a more perceptible amount is given off.

However, dust is not the only insalubrious agent in a cotton mill. A high and moist temperature is needed in the spinning rooms, and the more so where inferior cotton of short and brittle fibre is being spun. This state of things cannot be held as wholly accountable (acting as it does in conjunction with indoor confinement and the want of exposure to the free outside air and sunshine) for the washed-out, weakly appearance of most cotton spinners, and for the gradual sapping of their vitality and the progressive degeneration of the manufacturing population so generally observed.

The same conditions are met with among weavers, who work in an equally hot and still moister atmosphere. So serious to

health of these operatives did these abnormal conditions become, that it was deemed imperative to limit the degree of heat and of humidity in weaving sheds by a special Act of Parliament, passed in 1889.

Yet another incident of great sanitary importance occurs in the business of cotton-cloth weaving. I allude to the so-called "sizing" of the warp before weaving. This business is done by a small body of men before the "beam" is placed in position; but the weavers are the persons most exposed to the ills attending it.

In former years the materials used for sizing were of innocent quality, consisting of fermented flour and tallow; but these have almost everywhere been replaced by a compound of china clay and certain mineral salts, among which are chlorides of zinc, magnesium, and calcium, with a good proportion of sulphate of magnesia. These salts were added to the dressing, primarily with the view of preventing the formation of mildew on the cotton-cloth, especially where it had to travel long distances and to hot countries.

I do not know that the addition of these salts to the sizing is a source of special disease to the weavers; but obvious mischief to health resides in the combined china clay by the dust arising therefrom; for as those who have acquired some information respecting potters and their maladies will know, the so-called clay is a silicious material, and its dust most destructive to lung function and lung integrity.

Though diffused through a very vaporous atmosphere (and it so happens that the heavier the sizing the greater is the degree of heat and moisture required for the work in hand), the dust will find its way into the lungs, and there set up chronic inflammation in the air-tubes, and eventually in the lung tissue and cells themselves, followed by bronchitis and asthma, and finally by lung fibrosis—a lesion which symptomatically closely resembles pulmonary consumption.

The heavy sizing of cotton-cloth must be looked upon as a mischievous adulteration. The buyers of the most inferior cloths—chiefly the ignorant dwellers in eastern lands—actually buy in weight much more china clay than cotton; and I am assured by the clay merchants in the potteries, that far more china clay is consumed in weighting cotton cloth than in the manufacture of earthenware and china. In like manner, chemical manufacturers report that they make more sulphate of magnesia (Epsom salts) for the cotton mills than for the doctors.

Besides heat and watery vapour, and cotton and clay-dust, those other insanitary factors already described as common to all textile mills are to be taken into account in estimating the

effects of labour upon the employed. There is yet one other minor process not to be passed by without notice; I allude to the operation of "gassing." This belongs to cotton and silk alike. It consists in running the fibres with great velocity through a small jet of gas by the aid of machinery. By this proceeding, the irregularities and ragged sides of the fibres are burnt off, rendering them more suitable for fine spinning.

This process is productive of very hot shops, of air fouled with a large proportion of gas, and with no inconsiderable escape into it of carbonized dust, at once detected by the smell of combustion of organic matter, and by its irritant action on mucous surfaces.

Gassing rooms consequently are far from healthy places, and engender languor, sweating, and more or less anæmia from their heat and closeness; and on its part the diffused dust generates asthmatic breathing and cough, and leads to progressive disablement for work.

Reviewing the manufacture of cotton as a whole, in relation to its sanitary position, it must be called an unhealthy one.

Statistics demonstrate a high ratio of chest disease and consumption among its work people; shortened life, and a history of physical deterioration.

Apart from the habits of the people, both when at work and when absent from it, and which are open to very great improvements, visitors to cotton mills generally cannot fail to perceive sanitary defects, most of which are preventible. The prime sanitary agency called for is ample ventilation. Accompanying it must be reduction of temperature of work-rooms by avoiding, as far as practicable, its artificial elevation, by steam and hot-water pipes, and by the extravagant use of gas.

The abolition of this last-named incident awaits only the general adoption of electric lighting for its attainment.

Circumstances have occurred during the past twenty or thirty years which have greatly hurried onward material changes for the better in the construction and ventilation of textile mills—for what I am about to say applies to textile factories of every description. Those circumstances have arisen from the pressure of public opinion, from clearer views of sanitary requirements, from the operation of the factory laws, from the keenness of competition, from the improvement of machinery and of factory buildings containing it. This last result may be attributed to the dimensions and enormous value and weight of modern machinery, which alike demands space and sound building. Hence the erection of the almost palatial structures met with in textile districts, particularly noticeable in the instance of cotton mills.

Linen Manufacture.—But I must hurry on to find time for examining the sanitary aspects of the remaining manufactures to be examined—the Linen and Woollen.

The health aspects of the linen manufacture have been best described by the late Dr. Charles D. Purdon, of Belfast, who enjoyed unusual opportunities for observing them, by his position as certifying surgeon for that great centre of the linen trade, and by occupying several posts in connection with its medical institutions; and it was my good fortune to make myself acquainted with the details of the manufacture under his guidance.

Each of the processes, whereby flax is converted into yarn, and afterwards woven into linen cloth, possesses sanitary features of its own. A general sketch of them is all that I can venture on.

When flax is in-gathered, it is first steeped in water, and left for a lengthened period, so as to allow decomposition to set in, whereby the woody fibre decays, leaving the superficial strong fibres beneath the epidermis intact. This simple, crude proceeding gave rise to the exhalation of fetid gases, to the detriment and annoyance of persons they happened to reach. It is now more common to secure the like results in tanks, with the help of hot-water, in a much briefer space of time. This process is known as "retting." On its completion, the fibrous mass, when dried, was formerly subjected to a vigorous pounding action in the "scutching mill," whereby the fibres were separated from the decayed woody matter in a tow-like form. At the present day, the use of revolving cylinders, between which the flax is crushed, is largely substituted for the beaters of a scutching mill. The rude processes noticed, and particularly the scutching, were, by reason of the clouds of dust driven off, potent causes of ill health and lung disease. After scutching, the material passes to the "rough combers," who rid it of much dirt and waste by hand combs. Its next destination is in the "heckling" machines, wherein an active combing process proceeds, and which, when completed, evolves the flax in the shape of a clean, fine, fibrous, filmy rope—the "sliver," which passes on to the machine rooms, to be spun into yarn or "line;" just as is done in the case of cotton. With "heckling," the preparatory stage terminates. The manufacturing one is accounted to begin when the flax reaches the drawing and roving frames; and to end with the production of yarn or line ready for the weavers.

The mechanism, whereby all this is effected, is far too complicated for description alone, and its sanitary features are unimportant when compared with those of the preparatory stages.

Heckling is attended by clouds of dust, but being done in enclosed machines the greater part of the dust is kept from escaping into the workroom. However, some does so, and especially when for one reason or another—such as refilling with new flax—the enclosing-box is opened. Unfortunately, flax-dust is excessively irritating to the respiratory passages and lungs, and leads to chronic illness, assuming the form of wasting or consumption, with remarkably severe dyspnœa. In fact, the dyspnœa is out of proportion to the amount of dust inhaled, and points to some specific property of the flax itself specially obnoxious to the nervous system. The dust of flax is locally known as "pouce," and the sufferers from it in the early stage are termed "poucey." Its first symptoms are dryness of the respiratory passages, with huskiness in the throat, which soon increases and sets up cough and oppression of breathing. This dyspnœa, or asthma with cough, is the leading symptom, and assumes a a paroxysmal character, which in the later stages causes vertigo and staggering. The persistence of the symptoms induces debility, painful anxiety of the face, rounded shoulders, emaciation, and the well-known signs of consumption, soon ending in death.

The second stage of manufacture included under the general appellation of spinning, is not without some insanitary consequences. These happen especially in "wet spinning," in which the line, or "roving," traverses small receptacles containing hot water, whereby the rooms become filled with more or less steam, and the women's clothes considerably wetted.

There is a difference of opinion among flax spinners how far this heated and moist atmosphere is necessary to the successful production of yarn; and the belief gains ground that much freer ventilation of the shops than usual may be permitted, and that without detriment.

The wetting of the clothes is, in a measure, preventible by mechanical means directed to obviate the dispersion of the hot water; and the Factory Act provides that special protective coverings be supplied to the workwomen.

Wet spinning possesses this advantage—that it lessens the production and diffusion of dust, which is more pernicious than watery vapour. Nevertheless, as watery vapour, accompanied by heat, is productive of lassitude and sweating, and a cause of general debility with derangement of the digestive organs, besides increasing the liability to taking cold and to rheumatic affections, it is an imperative duty to devise means for its abatement.

In the weaving department the evils to contend against are excessive heat, unhealthy postures, confinement, and want of

physical exertion out of doors—a category of insanitary conditions needing no illustrations.

A subordinate branch of the occupation in which few are employed is that known as the "dressing" department. Here the workers are exposed to a temperature of 100° and upwards. Moreover, so fatal is this division of work regarded, that it is restricted to adults. Dr. Purdon calculated that the average duration of life among those who enter upon this occupation was little over sixteen years.

The account of the sanitation of the linen trade would be incomplete without some remarks upon certain subsidiary phenomena.

The principal of these are a temporary acute disorder known as mill fever, and the production of cutaneous eruptions. The fever attacks new hands within a few days of beginning work, and passes away spontaneously in less than a week without necessary medical treatment. The usual skin eruption is papular, and has been called by some lichen or eczema, and regarded by others as a folliculitis. It produces a prickly sensation, and is confined usually to young hands who have recently commenced work. Its cause is assigned to the flax-water by some, but by others, and with greater probability, to the oils freely used for lubricating the spinning machines.

Another form of eruption of more serious consequence to health is occasionally seen. It assumes a pustular character, not very unlike that of small-pox, and seems connected with the use of Russian flax, a circumstance suggestive of septic matter, when viewed in connection with what we know regarding Russian wool and horse-hair.

The Sanitation of the Woollen Manufacture.—Wool is turned to a variety of uses by different manufacturing operations, which, though varying among themselves, present a general similitude in principle, and happily are chargeable with few ill consequences to health; occupying in this respect a better sanitary position than those concerned in the production of cotton and linen; the dust of the animal fibre of wool seeming to be less obnoxious to the breathing organs than that of vegetable materials.

The woollen manufacture among those pursuing it is recognized as of three branches: known severally as the woollen, the worsted and the "shoddy" trade. In the last named previously used wool is the principal constituent, and it is chiefly concerned in the making of cloth and tweeds for male attire.

The operations antecedent to the passage of wool to the machine-rooms for spinning and its cognate processes exhibit the more important hygienic features. The first operation is

that of "sorting." This is done by men at large tables, who pick out the different qualities of the wool, and put aside what is unclean or otherwise unsuited for the purposes in view. This business, as I shall more particularly refer to by-and-by, is one attended by considerable danger to the workers, in the case of certain wools imported into this country; and I may at once add that the wools in use differ considerably in physical character in sources of origin and in the state of cleanliness in which they reach the factories.

However, at all times, wool as received requires preliminary cleaning from accidental dirt and from a copious normal amount of grease. The fatty matters have to be removed by repeated washings with hot water containing alkali. The intermingled solid particles of dust are got rid of by the "willying" or "winnowing" machines, which beat and shake them out whilst they, at the same time, divide the fibres. This purifying stage is completed by "carding machines," of like pattern and working as those used in cleaning cotton fibres.

These early operations are necessarily productive of dust, but this evil is very materially reduced by the employment of enclosed machines with extracting currents of air produced by ventilating fans.

Again, in the subsequent processes in the spinning-frames the fibres of the wool are lubricated by oil, usually the Galipoli oil, and thereby the production of dust obviated. And not only is spinning thus deprived of its injurious consequences as a dust-generating process, but the artisans themselves believe the constant contact with oil to be a positive health benefit and a help to nutrition. However this may be, the health of wool workers is far superior to that of cotton and linen hands, and certainly not inferior to that of silk hands.

Another superiority in sanitary position belongs to the woollen manufacture, arising from the intrinsic characters of wool. For instance, its fibres are stronger and longer, and therefore less liable to break. Hence it follows that they require less watching in passing through machinery, and therewith less strain on the attention and sight. Moreover, wool does not call for the heat and moisture needed in dealing with cotton and linen. Again, its fibres do not fray as do those of the other textile materials named, and consequently are less fragile and dusty.

The *making of shoddy* is more complicated and is attended by more dust and heat.

At least a very considerable proportion of the cloth woven for male attire is a resuscitation of former apparel, with some addition of fresh wool and cotton. The materials used are rags

collected at home or imported from abroad, and are of a very miscellaneous character, and too often dirty and offensive. Hence the first business is to steam, wash, and cleanse them from dirt, and the next to sort and tear them up. The sorting is done by poor women, and the tearing up by a machine known as the "devil." Into this they are thrown and there exposed to a rapidly revolving apparatus of teeth, whereby they are divided into small fragments, which pass on to a "scribbling" or grinding mill, and are there reduced almost to a fine powder preparatory to the operation of carding.

The sorting of rags is a dusty business, and the reception of rags from all sources might be considered as a dubious proceeding, likely to spread contagious diseases. Such an accident has happened, chiefly in bygone years; but a special inquiry made some time since proved how very seldom a misfortune of the kind occurred in sorting rags, whether for shoddy or mungo mills, or for paper factories. The tearing up of the rags was formerly almost wholly done by hand, and was attended by many evils from the resultant dust; but now the machine "devils" have supplanted that proceeding, and the dust from the process, which is very great, is prevented diffusing itself in the air by the enclosure of the apparatus, and by a strong extracting current of air, which withdraws and carries it away along a flue to the outside of the place of work.

The wool fibres having been reduced to a powdery mass, are next freely besprinkled with vegetable oil, and then subjected to the "willying" and roving machine to produce a "sliver." In the next place they are spun into yarn, and eventually woven into cloth. In these proceedings the addition of oil happily controls the rising of dust from the disintegrated wool, and must be reckoned a salutary proceeding.

When the cloth leaves the weaver it has to undergo the operations of "dyeing," of fulling and dressing, of raising the pile, shearing and pressing, and afterwards of exposure to steam. The hygienic features however that attach to these proceedings need not here detain us. Heat is the chief factor noticeable, and these final processes, as a whole, occupy but few workers.

When Dr. Greenhow visited the shoddy-mills he met with a febrile complaint among the employed, known as "shoddy fever," due principally to the action of dust from the grinding apparatus, which at that period was commonly unenclosed, and consequently emitted clouds of dust. My enquiries at cloth factories failed to discover the prevalence at the present time of this disorder, but further investigation is needed.

It fell to the lot of newly employed hands to suffer this shoddy fever; and Dr. Parsons, of the medical department of

the Local Government Board, who, a few years since, investigated the health conditions of the manufacture of "Flock," describes the occurrence of "flock fever" similar in all respects to "shoddy fever," and like it affecting only those who enter anew upon the business, continued occupation begetting tolerance of this unhealthy consequence.

It will be remembered that a febrile disorder seizes on those who enter upon flax-working, and it appears clearly that the conditions of mill-life are calculated to engender such attacks: and, in my belief, this malaise occurs whatever be the material in course of manufacture. For even in cotton mills, novices at work where unnatural heat and closeness exist, and where dust is generated, have to pass through a seasoning process of constitutional disturbance of short duration. We can, indeed, well conceive that the dust inhaled plays an important part in the matter, though it be not the only agent. On entering shops devoted to the preparatory stages of manufacture, a visitor encounters a feeling of oppression and general discomfort connected with the heat, and with the peculiar odour of the manufactured article and of that coming from machinery.

Other manufactures in which wool is the chief constituent are hosiery-making, blanket and carpet-making. These, though differing more or less in the nature of the processes passed through and of machinery employed, have no such pronounced sanitary incidents that I need linger upon them in this lecture.

But I cannot quit the subject of wool in its sanitary bearings without adverting to the serious consequences that attend, now and then, the primary operations of opening out the bales and sorting their contents. For in these it is that the workers encounter the malady known as "wool sorters' disease," which is in reality anthrax.

The precise nature of this malady was not at first realized, whilst the mortality arising from it caused it to be viewed with terror. But ere long its true character as anthrax was detected, and this "wool sorters' disease" was further identified with a like malady that happens to horse-hair workers and to those handling infected hides and skins, mostly those received from foreign parts—especially from Russian Asiatic territories.

At the same time its manifestations differ, for anthrax will at one time display its virulence, especially as a local lesion; whereas at others—as happens with the wool sorters' malady—it exhibits its presence chiefly by malignant fever without furuncular abscesses.

A review of the whole subject of the Sanitation of Textile Industries will show that their leading health features are to be found, firstly, in the conditions of associated labour, in confine-

ment within rooms or shops which may be deficient in space. badly ventilated and overheated; secondly, to a lesser degree, in the circumstances, inseparable from the use of machinery, among which are vibration, noise, monotony of work, and the strain of watching the minute and very rapid movements of the machinery; thirdly, in the dust evolved in the course of manufacture from the material used, an evil principally attaching to the earlier operations, but varying greatly in degree according to the nature of the substance dealt with; fourthly, in special auxiliary conditions this or that manufacture may call for, such, for instance, as the presence of a hot steamy atmosphere, the employment of oils, or of substances introduced in dressing, foremost among which is the china-clay employed in cotton-sizing; fifthly, in the accidental presence of noxious or poisonous matter in the rough material to be manufactured, as illustrated in wool sorting.

Add to the foregoing incidents those common to all sedentary occupations, constrained positions of the body, and want of physical out-door exercise, and we cannot fail to recognize a series of hygienic conditions and surroundings which must sap the health, lower vitality, engender constitutional weakness, and deteriorate the race, besides being accountable for setting up active present disease, and thereby increasing in every direction the rate of mortality, and lessening the value of life.

On a retrospect, however, this consolation reveals itself, that the major part of the insanitary conditions are more or less remediable, and justify the expectation that, in course of time the enlightened efforts of employers, better instruction of the artisans in sanitary knowledge, coupled with due attention thereto, and the genius of engineers, will concur to very materially diminish the unhealthiness of the Textile Industries.

THE METALLIC POISONS LEAD & ARSENIC, AS MET WITH IN OUR INDUSTRIES.

By THOMAS OLIVER, M.A., M.D., F.R.C.P.,

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Read December 8th, 1893.

When I accepted the invitation of the Council of The Sanitary Institute to deliver one of the lectures of the present course, I did so with misgiving, for I felt that not only was I a stranger to a London audience, but that I had little or nothing to say that could either interest or instruct you. It was suggested, however, that as I had given some attention to the subject of lead poisoning, it might serve as a useful text from which to address you.

Lead poisoning is of greater importance than people generally imagine. It is a subject of almost national importance, for have there not been within our experience several epidemics of plumbism in many of the large towns in England, owing to the faulty conduction of the water supply, and several cases from the poisoning of food cooked in tin utensils? Besides, lead is known to be a dangerous metal, and thus it is that those who are engaged in the manufacture of its compounds, such as the white lead worker—those who manipulate them like the house painter or the dipper in the potteries — or those who are employed in enamelling, too frequently suffer from inhalation of the dust.

I am not here to-night to discuss the dangers attendant upon the conduction of drinking water into our houses through leaden pipes, or to show you how water that has trickled through peaty soils, rich in decaying vegetable matter and iron, dissolves out lead and thus becomes a source of danger to the consumer. It is sufficient to be reminded that drinking water should never be stored in leaden cisterns. Water used

for drinking or culinary purposes should come straight from the main and every morning should be allowed to flow for a few minutes, so that what has lain over night in contact with the leaden pipes may be allowed to escape. The consumption of this water has long been recognised as a source of danger. The same is true of malt liquors. Barmaids who lap up the beer that has fallen on the leaden slab on the counter, and barmen who have indulged in the first swill of beer drawn from the tap in the early morning, have to my knowledge forfeited their lives through their indiscretion. It is stated that the extensive use of foreign lead for pipe-making in this country, and from which the silver has been extracted, is more apt to be acted upon by fluids of all kinds than the native lead which is poor in silver, and therefore not worth the trouble of extracting.

The entrance of lead into the system in infinitesimal quantities—no matter the channel by which it gains admittance or the form in which it is absorbed—cannot go on without serious impairment to health. Thus do we seek to explain the rapid breakdown of the constitution of the lead worker, the colic of the house painter, and the extreme headache and anæmia of the lady of fashion, who tries to deceive herself and her friends by obscuring the whitening touch of age by the use of certain hair restoratives.

I am here to-night to deal with lead poisoning in its relation to certain trades, and particularly in regard to lead making itself. Lead mining in this country is an old industry. It dates back to the Roman occupation and has been constantly carried on since 1401. Its home is the North of England. The profits derived from lead mining contributed in no small measure to the revenue of the Prince Bishops of Durham, and whilst the industry has enriched several of our county families, it has given employment to several people in the thinly populated dales of Durham and Cumberland. What is called the "lead country" is limited to the upper reaches of the rivers that arise on either side, and to the south, of the Pennine Range. Lead is also found in Cornwall, Wales, and the Lake District. The surface of the country is generally heather-clad moorland, 1000 to 2000 feet above the level of the sea. The miners live in the villages lower down and have thus frequently to walk from two to four miles from their homes to the mine. Dr. Robinson, of Stanhope, has in an interesting paper, "Lead Miners and their Diseases," told us how the miners and their families, shut up in the deeper recesses of these dales, and removed from centres of civilisation have seen little of the life that lies beyond. They have migrated but seldom; they have intermarried

much amongst themselves and in this way they have become not only one family industrially, but socially. To circumstances such as these must be attributed their predisposition to certain diseases such as phthisis—a morbid condition to which they are peculiarly susceptible. Like the Irish peasantry, they cling with a wonderful tenacity to the mountain sides and dales inhabited by their ancesters for generations. The wages of the men are seldom more than 10 or 12 shillings a week, and yet unless they are compelled by sheer necessity, they will hardly leave "the badly paid, disease producing, and life-shortening employment of a lead miner for more lucrative work in the coal pits and iron works of central and eastern Durham." As a class, lead miners are intelligent, religious, and temperate.

Metallic lead occurs as "veins" in the rock, varying in thickness from 1 inch to 15 feet. In this country the ore is found principally as galena, or lead sulphide, in which silver and sulphide of antimony may be present, or in the form of carbonate or white lead ore. The ore that is imported from New South Wales is largely carbonate, and it is owing to this fact that lead mining in that colony is productive of greater risk to health than in this country. Saturnine poisoning is practically unknown amongst our miners, owing to the ore being non-volatile and insoluble. In lead mining there are fewer risks than in coal cutting and coal raising, but the lead miner is exposed to risks from which the collier is to a large extent exempted. The free ventilation of coal pits insisted upon by Government, has removed many diseases from which miners in the early part of this century suffered. Not so, however, with the lead miner. He has to get the ore out of the veins in the hill sides, and in order to do this a shaft is sunk as in an ordinary pit, or a drift is driven into the hill side. Whichever method is adopted, one is no better than the other, ultimately, so far as ventilation is concerned. Frequently a lead mine may extend one or two miles into the side of a hill and may reach a considerable depth, exit from the bottom of which can only be accomplished by climbing a series of ladders. Ventilation of such a mine is not only difficult but expensive. At all times it is faulty. In the deeper recesses of the mine the air may be so contaminated that the tallow candles which the miners carry cease to burn. Ordinary atmospheric air contains 21 per cent. of oxygen and 79 of nitrogen, with just a trace of carbonic acid; but in the air removed from lead mines, Dr. Angus Smith found in 110 analyses, that in 12·7 per cent. it was pure or nearly so, decidedly impure in 24·5 per cent., and extremely bad in 62·7 per cent. In one instance the oxygen was as low as 18·27 per cent., and the carbonic acid reached 2·26 per cent., a high

percentage when it is remembered that an atmosphere above ground is bad when it contains ·1 per cent.

Carbonic acid is one of the great dangers to the men, and there is a tendency for it always to be present in excess as it is given off from the lungs of the miners in respiration, and the combustion of the candles as well as from the strata in which the men are working. Add to these facts the deterioration of the air of the mine by the use of dynamite and from the explosions of gunpowder, and you have an atmospheric condition in the mine which frequently obliges the men to retire to the mouth of the pit in order that the needs of respiration may be satisfied. What with impure air and the inhalation of the dust and grit from the limestone rock, the lead miner is exposed to risks that are in constant operation during the whole period he is at work. When to these are added the fact that the mines are warm and the men on leaving are overheated, owing to the exertion required in scaling the ladders, and are obliged to trudge home two or three miles across a bleak moor exposed to biting winds and in all kinds of weather, we can readily understand how it is that many of them succumb to such acute illnesses as pneumonia, or how the neglected cold or pleurisy, acting in conjunction with a family predisposition, too frequently throws the miner into consumption.

It was to diminish some of the inconveniences necessarily connected with the distances that separated the homes of the lead miners from their field of operation, that "Lodging shops" were built by the proprietors, and where for three or four nights a week the miners reside. Dr. Robinson states that in Weardale 166 miners make use of these buildings. Without a fireplace, or any means of ventilation, the bed-rooms, which are in a filthy condition, are crowded to excess—twenty men will occupy a room with breathing space for only eight or ten. Inhaling for forty hours every week (five shifts of eight hours) the vitiated atmosphere of the mine, and sleeping in a room the beds in which are so close to each other that there is scarcely room to pass between them—beds which are almost continually occupied, for the mattresses have scarcely got cooled ere they are lain upon by the succeeding shift; with conditions such as these I ask how is it possible for these working men to be healthy? When we know that the air of the "lodging shop" fairly reeks with the effluvia from the bodies of the inmates, that thorough ventilation is impossible, that the miner who is in the early stage of consumption takes his place amongst the rest, and that with each expectoration he spits upon the floor, myriads of tubercle bacilli are possibly liberated, then we have an atmosphere not only poisoned by

excess of carbonic acid, but ladened with micro-organisms, which are believed to play an important part in the causation of consumption. No wonder therefore that we learn of pulmonary diseases, acute and chronic, being the lot of the lead miner. They shadow him at his work in the mine, in the lodging shop when asleep, and in the long, cold walk across the moor.

Setting aside these risks, it may be repeated that the lead miner in this country never suffers from plumbism. There are fewer men engaged in the mines to-day than formerly. Many of the lead mines in the North of England are closed and have been for years. The importation of lead from Spain and Australia, richer in silver and thrown cheaply into the English market, has largely lessened the output of native ore. Lead mining is with us therefore a declining industry. Foreign competition has practically strangled it. Whilst the lead mines in this country are free from saturnine poisoning it must not be inferred that this holds good all the world over. In the Report presented to the New South Wales Government by a committee appointed to enquire into the prevalence and prevention of lead poisoning at the Broken Hill Silver Lead Mines, it is clearly demonstrated that several of the miners have suffered from plumbism; also that whilst the getting and working of the ores composed of sulphide of lead or galena are attended with little risk to health, those that contain carbonate are dangerous, a danger that increases in proportion to their friability and dustiness.

I have always maintained that the special dangers incidental to the manipulation of lead are not met with in the getting, but commence with the smelting of the ore. Smelting of the metal is not a large industry in this country. It is an occupation attended by a certain amount of risk. Lead is volatile at high temperatures. Inhalation of the fumes of the molten metal by the smelter was in days gone by a frequent source of poisoning. In one instance that came under my own observation four sons in one family—all strong healthy men—died at an early age, under 30, from chronic lead poisoning. At present the risk to the smelter is practically nil. Owing to the hood which is placed in front of the furnace, the draught carries the fumes all up the chimney. Lead smelting can scarcely be regarded therefore as a dangerous occupation. It is absolutely necessary however that the chimney stalk should be high, so that the fumes may be widely dispersed by the wind. The lighter dust thus floats away, and is carried a great distance, but the heavier particles necessarily fall close at hand, and become a source of danger. Cattle grazing in the fields near lead smelting works have suffered from colic—they are said to be "bellond," an old

French word, the interpretation of which is briefly "belly-bound." Horses, sheep, and oxen, that have eaten of the contaminated herbage have died, and, in the processes of litigation that followed, farmers have succeeded in obtaining compensation from the factory owners for the damage thus inflicted upon their flocks. In Germany an interesting circumstance was noticed by Schroeder and Reuss. In close proximity to some of the forges they noticed that the red berries of the mountain ash trees were regarded as a favourite food by the thrushes and finches in the autumn, as well as by nearly all the birds that remain there over the winter. Below and close to these trees they often picked up birds sickly or dead. Those that were alive had their extremities contracted, and their power of flight appeared to be paralysed. Some of them died in a few days, powerless in their attempt to flutter. The birds had eaten the berries upon which were deposited the particles of oxide of lead, and had thus poisoned themselves. Plumbism was not confined to the small birds, for the wild animals that roamed in the woods close by also suffered from paralysis, the stags amongst other things exhibiting a peculiar defect in their antlers. On meadow hay taken from the neighbourhood of the Altenan forges, Frëytag found a deposit of lead oxide equal to ·0027 per cent.

I have alluded to the Broken Hill Mines. As illustrating the poisonous nature of the fumes emitted from their chimneys, I need only mention that a child aged five years died from lead poisoning. She had been in the habit of plucking flowers and putting them in her mouth, the flowers bearing visible particles of flue dust which had fallen upon them from the smelter stack under the shadow of which she resided. Cows, horses, dogs, and fowls died close to the mines. The soil surface on being analysed was found to contain a percentage of metallic lead varying from ·05 to 4·81. In my own neighbourhood I have known dogs that had slept upon the jackets of their masters when engaged in the smelting shops, licking the sweet dust or that had lapped the water trickling from lead works, suffer from colic or exhibit a peculiar form of nerve symptoms due to the effect of lead upon their brain. Wherever lead smelting is carried on to any extent, there is a risk of the pasturage becoming contaminated. Whilst the risk to the smelter has been greatly diminished by the hood placed in front of the furnace, nearly all the men thus engaged are pale and exhibit a well-marked blue line along the margin of their gums. One danger however still remains, and that resides in the flue itself. The smoke that issues from the chimney of a smelting furnace is composed of two parts, one the ordinary fume from the

metallic vapour arising from the molten metal and mixed with atmospheric air, and the other the heavier part or flue dust in which lead is sometimes present to the extent of 20 or 40 per cent. These flues have to be cleaned out, and in some instances men have told me when thus engaged they have been obliged to come out, suffering from dizziness and a splitting headache, and have vomited freely.

English pig lead contains very little silver—seldom more than eight or ten ounces to the ton—so that it does not pay the manufacturer to extract it. In the Spanish lead there is from forty to eighty ounces to the ton, and in the Greek eighty ounces, whilst in the Australian metal the silver is very variable. It may be as low as sixty ounces to the ton or it may range from 400 to 500 ounces, and in some exceptional instances I am told it may run 1,000 ounces to the ton. Under these circumstances the silver is worth extracting from the lead, and on Tyneside desilverization is largely carried on, so that we send to the mint and the buyers in London several tons (upwards of fifty tons) of silver every year. The silver may be extracted by what is known as the Zinc or Parkes' process, the principle of which depends upon the fact that when silver-lead ore and zinc are melted together at a suitable temperature and allowed to cool slowly, the zinc alloys itself with the silver and rises with it as a crust which floats on the molten mass and can be skimmed off from it. By repeatedly melting and concentrating these rich crusts, and the adoption of certain processes to recover the zinc, it is easy to obtain pure silver. Workmen employed in desilverizing do not appear to suffer. I have never known of a case of lead poisioning amongst them. In all the works that I have visited I have always found the men thus employed very healthy, well developed, good specimens of the British working man.

The manufacture of red lead is an easy, and on the whole not a very harmful, process. Pig lead is placed in a furnace, and when molten a workman keeps stirring the mass by means of a long iron rake. By degrees the metal becomes oxidized, and is removed from the furnace as a yellow powder, known as Massicot. This is subsequently returned to the furnace, and again raked up and down so as to allow of its complete oxidation. When this is accomplished it is drawn out, and it is noticed that the yellow colour of the Massicot has been replaced by one of a dark raspberry red. This on cooling and on exposure to the air gradually assumes the colour of the ordinary red lead of commerce. It is an oxide of lead, and in its manufacture, whilst we admit that the work is hard—something of the nature of the puddling of iron, though not so severe—any

danger to the individual from lead poisoning is minimised by the free ventilation in front of the furnace, and by the draught carrying away all the fumes. The danger arises when the manufactured article is removed from the furnace. It is a coloured powder, and as the heat at which it is drawn off is considerable, there is naturally given off a certain amount of fume, and later on, red dust. When a sunbeam slants through one of these shops you can see the red particles floating in the atmosphere. As the dried red lead is frequently packed into casks in the same part of the factory where it is manufactured, there is disseminated a large quantity of dust through the air, inhalation of which may cause colic. Colic and wrist-drop, or paralysis of the hands, occurs amongst red lead workers, and are due to inhalation of an atmosphere charged with red lead dust. Careful attention to the raking-out of the furnaces and the packing of the dried red lead in closed chambers, along with scrupulous cleanliness on the part of the workmen, would tend still further to diminish risks to health.

So far as we have gone it cannot be said that lead making is a very dangerous employment to the individual engaged in it. When we come to consider the manufacture of white lead, we observe that at certain stages of the process a good deal of dust is evolved. It is the inhalation of this fine penetrable dust, and the fact that women are largely employed in the trade, that have gained for this industry a bad name. We believe that women are much more susceptible to the influence of lead than men. This statement, for which I am largely responsible, has been disputed, but an increasing acquaintance with the subject, an extensive hospital experience of plumbism, and renewed experimental investigation upon animals, lend weight to the opinion that women are not only more susceptible than men but they are so at an earlier age. In addition there is a greater tendency for lead poisoning to assume its most serious form, in which headache followed by convulsions and coma are the most prominent symptions. Such an illness is frequently fatal within three days after its development. It is because several young females engaged in the white lead works have died rather suddenly, that the Home Secretary, influenced by public opinion, nominated a few months ago a commission to enquire as to how far their fatal illness could be attributed to the special nature of their employment and how far it is preventible.

White lead is made in considerable quantity in this country. On Tyneside alone the annual out-put is about 15,000 tons, and were trade good, there is a productive capacity for two or three thousand tons more. English white lead has to compete with that of foreign manufacture, and were it simply a question of

quality, *e.g.*, purity of colour, covering power and durability, educated opinion would at once decide in favour of the home-made article. No method of manufacture can touch that which is generally in use in this country and which is known as the old Dutch process. There are two other, the "chamber" and "precipitation" processes. On the Continent white lead is largely made by the precipitation process, but the quality of the article produced does not compare favourably with ours. The Dutch method has long been in use in this country. Thin sheets of metallic lead placed in a chamber spoken of as the "blue bed," are exposed to the vapour arising from acetic acid. The acetate of lead so formed becomes the subacetate, and is subsequently converted into carbonate of lead from the carbonic acid arising from the tan in which the jars containing the acid are deposited.

After describing the Dutch method the lecturer said, so far as this process is concerned the first element of danger to health arises when the metallic lead is converted into carbonate. This occurs in what is known as the "white bed." Manufacturers generally allow thirteen weeks for this process to be accomplished. It is believed by some that if the conversion of the acetate into carbonate is incomplete, and the stack or "white bed" is opened too soon, that the girls sent in to strip it suffer more from headache than on other occasions, owing to the acetate of lead floating in the air with carbonate being a finer dust and more soluble, and therefore more readily absorbed than the pure carbonate. It is advisable that the stack should not be opened too soon, that when stripping a "white bed" the surface should be sprinkled with water, and that those who are stripping, but not those who are carrying the white lead, should wear respirators. No respirators, however, can keep out all the dust. They are certainly preventives. Without them a larger quantity of fine lead dust would doubtless be inhaled, but they are not an absolute protection.

It is after the white lead has been washed and ground and the wet pulp placed in the stoves for a few days that the principal danger arises. It is the drawing or emptying of the stoves that tells hardest upon the girls. A few hours in the stoves every week may, if excessive care is not taken, very quickly develop symptoms of saturnine poisoning. The wearing of overalls and respirators, careful cleansing of the hands and teeth before eating, a good meal before starting the work of the day and a bath at the end of it, and only one day's work a week in the stoves are precautionary measures, the value of which cannot be over-rated. A better procedure, however, would be the abolition of the present stove or drying chamber and the substitution for it of one that could be filled and emptied mechanically.

In addition to this if female labour was abolished in this department and the "white beds," we should hear little of white lead-making as a deadly industry. It is only on financial or economic grounds that females are employed, the wages of women being less than those of men.

I need scarcely waste your time over a description of the chamber and precipitation processes.

There is no better preventive against lead poisoning amongst operatives than working upon a full stomach. Lead enters the system by the lungs during respiration by inhalation of the dust, or it is swallowed with the saliva and enters by the stomach. Some time ago I proved experimentally that during the processes of artificial digestion, if food were being digested at the same time as lead, only the smallest quantity possible of the metal passed into solution—only the smallest quantity therefore became capable of absorption. If, on the other hand, gastric juice was allowed to act upon lead alone a much larger quantity passed into solution. What I demonstrated experimentally is confirmed by experience amongst the workpeople themselves. Safety for them consists in their having a good meal before beginning work. Employers recognise this fact and of their own accord provide them with a free breakfast.

The compounds of lead are all more or less dangerous according to their solubility. They produce their baneful effects upon animals as readily as they do upon men, and amongst them it is noticed just as in the human subject, that females are more readily influenced than males. Lead strikes a deadly blow at the reproductive powers of the female. If pregnant she miscarries. In the human female, miscarriage not only occurs once, it may be repeated time after time. Should a child be born when a woman is following her avocation at the lead works, too frequently it is dead or dies shortly after birth from sheer exhaustion, or it dies a few weeks or months after from convulsions. These are facts that have been placed beyond all shadow of doubt.

What I have said of white lead applies equally to orange lead: it too is a carbonate. When administered to animals it causes albuminuria, paralysis of the limbs, and death.

Whilst recognising that the manufacture of white lead is a dangerous employment, we must admit that the fault is not altogether on the side of the employers. To my knowledge many of the owners of the factories take a warm interest in their workpeople. They recognise that the making of white lead is not without risks and they do all they possibly can to diminish them. Of their own accord, and at their own expense, many of them provide breakfast for the hands, whilst the wearing of

respirators and overalls, the taking of baths and the drinking of acidulated beverages are insisted upon. In addition the services of a doctor are gratuitously supplied. It is just in those factories where all these points are attended to that we seldom hear of cases of lead poisoning. Many of the females employed belong to the lowest grades of society and are extremely poor. Many of them are intemperate, whilst others are bravely struggling with adversity, and owing to the death or ill-health of their husbands, are tempted by the good wages of the white lead factory. Poverty from some cause surrounds most of them and it is to the improper feeding, the scanty clothing, the imperfect housing, and to intemperance in alcohol that must be attributed a large part of the lead poisoning met with in this industry.

You cannot examine a sample of white lead made by the old Dutch process without being impressed by its whiteness and purity. I know nothing equal to it. As a pigment there is nothing that surpasses it in colour, covering power, or endurance. In expressing this opinion I am supported by a large amount of evidence given by experts before the Home Secretary's Committee. There has been thrown upon the market as a substitute for it the white sulphate of lead. Its process of manufacture has so much improved that it is being run as a rival to the carbonate. The makers claim for it that it stands exposure to the air better than the carbonate. Opinion is perhaps not yet quite ripe for a complete settlement of all the points in dispute—viz., colour, covering power, and endurance—but the answer will come in due course from the paint mixers themselves. The manufacture of white sulphate of lead is simple. It may be made by the precipitation process, or Galena is thrown into a furnace along with coke, with the result that the sulphide of lead becomes oxidized at once into sulphate, the white fumes of which can be seen passing off into a chamber, where they settle in water. The sulphate of lead pulp is subsequently dried, ground, and mixed just as is done with the carbonate. Sulphate of lead is not so dangerous a compound as the carbonate; it is less soluble. On no account, however, can it be claimed for it that it is absolutely free from danger. No compound of lead is perfectly harmless. Animals to whom I have given the white sulphate in their food have died from lead poisoning. They became paralysed, and after death lead was found in the liver. It takes, however, a very much longer time for the sulphate of lead to destroy life than does the carbonate.

Some have proposed oxide of zinc as a substitute for the carbonate of lead, and whilst the opinions of house painters

are divided upon this point, it is admitted that for internal decorative purposes, such, *e.g.*, as the painting of ceilings and the woodwork of rooms, oxide of zinc or zinc white is a very serviceable pigment. In several instances, ceilings painted with zinc white have kept their colour for a longer time than those painted with white lead. It has been urged against the employment of zinc white that it is too readily discoloured by ordinary linseed oil, and that it takes too long to dry even if you use a refined linseed oil. Mixed, however, with boiled pale linseed oil, Mr. J. S. Macarthur, of Glasgow, says this drawback is overcome; that with judicious management and the proper proportions of turpentine, it makes a far nicer surface of paint than does the carbonate of lead. The difference in price between the two substances is at once a barrier to the general employment of zinc white. Genuine zinc white sells for £19 a ton, carbonate of lead for £15 or £16, and the white sulphate for £12 or £13. There is too another objection, and it is that the manufacture of oxide of zinc is not a home industry. The mines from which it is taken are in Silesia.

Lead enters largely into very many of our industries. Chromate of lead, for instance, is used as a dye. Dr. Scott, of Tollcross, near Glasgow, was the first to show how yarn, dyed with chromate of lead, might seriously affect the health of operatives. Several of the hands, particularly the women, employed in a wool factory in his neighbourhood suffered from attacks of colic and vomiting, and were anæmic—the cause of which was for some time obscure. It was not until Dr. Scott had seen the peculiar yellow vomit of one of the sufferers that his suspicions of lead poisoning from the chrome dye were aroused—a suspicion unfortunately too soon confirmed by the rapid and unexpected death of a young forewoman in that factory. It then became clear that from the yellow yarn stained by means of lead chromate a very fine dust was given off, which impregnated the atmosphere of the carding room, at that time very badly ventilated. Believing that this was the source of the trouble, Dr. Scott suggested the introduction of a fan into the room, by means of which not only was fresh air drawn into the room, thus diluting the poisoned atmosphere, but removal of the chromate of lead dust also accomplished. The result of the introduction of the fan was that for two years not a single case of lead poisoning occurred in that factory. Shortly after this however a very cold winter set in, and the girls complained that since the introduction of the fan the carding room had become so cold that it was impossible to work therein. Out of consideration for the complaints of the girls, and from ignorance of the circumstances upon which their safety de-

pended, the manager closed the fans, and then came such a rush of cases of lead poisoning that not only were the fans once more successfully put into operation, but the validity of Dr. Scott's opinion was amply confirmed.

We are continually being reminded of the keenness of competition in commercial circles by the numerous advertisements that we see everywhere. The walls of our railway stations are now nothing but a series of sign boards whereon in black and white or blue and yellow, manufacturers seek to laud their own special wares. Out of this method of advertising has grown, practically speaking, a new industry, viz., the enamelling of iron plates. It is an industry chiefly confined to Wolverhampton and Birmingham. The making of these enamelled plates is not without some risk to health. At first lead and arsenic were employed but the use of arsenic has been almost entirely dropped. Lead, however, is still made use of either in solution or in the form of a very fine grit like ground glass. Roughly speaking, there are two methods of enamelling, the "wet" and the "dry." In the wet process the prepared iron plate is swilled with a solution which may or may not contain lead. The plate is placed for a few minutes in a furnace; removed and allowed to cool. It is again swilled. The solution this time may contain lead. The plate is again placed in the furnace and enamelled. In the third coating or laying-in as it is called there is generally a large quantity of lead in solution, sometimes as much as 20 to 30 per cent. The plate is not, after this coat has been put on, placed immediately in the furnace but is allowed to dry by exposure to the air. It is then taken to another part of the factory where girls place upon it stencils cut out of paper or very thin metal—the letters of the stencil being those that are subsequently to appear as the advertisement on the finished plate. The girls leaning over these plates, and with small brushes in their hands, brush off the last coating exposed through the cut letters of the stencil, and in doing so raise a cloud of coloured dust. This dust, strongly impregnated with lead, not only falls upon their clothing and their hair—to say nothing of their bare arms and hands—but is inhaled. At Wolverhampton we found that this enamelling of iron plates was not altogether free from some risks to health. With proper precautions however the dangers can be minimized by the introduction of fans so as to drive the dust downwards from the plates as they are brushed by the girls, by the wearing of respirators, by a thorough washing of the hands and face before eating, and by the operatives taking breakfast before commencing work in the morning.

I have dwelt at such length upon the employment of lead in

our industries that I have left myself little time to discuss the question of arsenic. A short while ago public opinion was unduly aroused by articles in the daily press indicating the risks to health incurred by those engaged in the manufacture of emerald green. Arsenic is an escharotic, *i.e.*, it has the power, if the skin is broken, of causing ulceration and it was maintained that those who were employed in its manufacture suffered from open sores on various parts of the body. I have visited the large colour works in this country and examined the operatives, and I must admit that I saw nothing of the horrors that are attributable to arsenic, although the men admitted that if great care and cleanliness were not exercised there was a risk of the skin becoming affected.

In the manufacture of emerald green, white arsenic or arsenious acid, soda, sulphate of copper and acetic acid are used. The sulphate of copper is dissolved in water. A solution of arsenite of soda is made by boiling together arsenious acid and a solution of soda. This is added to the fluid containing the copper sulphate and after a time acetic acid is also added. Emerald green forms and falls to the bottom. It is well washed by being stirred up several times with water. Up to this stage there is nothing deleterious to the health of those engaged in the manufacture. The men employed are not exposed to any noxious influence. The remaining operations, however, are dusty and must be carried out with caution.

The washed emerald green is drained from the water in cloth filters, and this moist clay-like mass is placed on wooden racks, covered with paper, and dried in a stove. When dry, it is removed and "shot" into large iron drums or kettles. This may give rise to considerable dust. Having been "shot," the colour is mixed in a revolving drum and sifted in a sieve with all the currents arranged so as to carry off the dust. The emerald green is then taken to the packing room to be put into self-closing tin cans. Little dust is generated during this operation. The draught is so arranged as to carry away any dust that may be created.

Certain precautions must be attended to. The men work in this particular department only one day in the week, respirators and overalls are worn, and baths are provided. Cleanliness of the person and of the hands before eating, and above all, avoidance of exposure to the green dust if there is the slightest abrasion of the skin are to be insisted upon. The usual ill effects are redness and soreness of the skin chiefly round the nose and mouth where the edges of the respirator fit. These are due to the skin at this particular part being kept moist by the expired air, and are also to be attributed to friction of the

respirator against the skin. If the men do not wear respirators, they suffer from vomiting.

Emerald green is used as a pigment, but in addition large quantities of it are exported to Colorado to put an end to the destructive beetle.

We are frequently reminded that disease treads closely upon the heels of civilization. It would appear as if ill-health followed in the trail of some of our great industries. Can we prevent it? New industries are no sooner developed than upon the operatives are exerted some of their morbid influences, and it is surely for us as sanitarians to diminish or abolish these attendant ills. We live in a humanitarian age. In no epoch in the world's history has the life of man and woman, quite irrespective of their station in society, had a higher value assigned to it. In spite of the perplexing doubts that surround modern life and the increasing number of social problems that await solution, the answer to the question "is life worth living" is found in the expressed desire of the majority to have it prolonged when it is assailed. The better housing of the working-classes and the means given them of obtaining more wholesome food, have done much to prolong life. Whilst the aim of modern Sanitary science has been to develop health in the home; let us not close our eyes to the necessity of promoting health in our industries.

MANUFACTURE OF ALKALIS AND ACIDS.

By WATSON SMITH, F.I.C., F.C.S.

Read December 14th, 1893.

Introductory.

Having very much to crowd into this one lecture, I shall not waste your time or add to my own embarrassment by commencing with anything worthy of the name of an introduction. As far as any further movement towards legislation is concerned in connection with the question of the hygiene of processes and occupations involved in the manufacture of alkalis and acids, since such manufacture consists of a series of chemical operations on a large scale, it was absolutely necessary in the first instance *to make inquiry*. But the recent inquiries at first instituted by our Government, as well as by certain of our newspaper commissioners, owing to the fact that scientific and expert knowledge had been overlooked, only led to the raising of a general dust or fog. Only one instance is necessary to illustrate the depth and thickness of that fog, and as it is an instance both brief and amusing, I will give it you. During the Government inquiry in November of last year, a workman gave the alarming information that sometimes the Bleaching Powder Chambers were in a red hot condition when the packers were required to enter them. When I tell you that bleaching powder chambers are almost invariably made of thin sheet lead supported by light woodwork, and that heat is the ruin of bleaching powder, that a red heat and bleaching powder—or even a bleaching powder chamber, are nearly as incompatible as a red heat and iced cream, you may imagine the wrong feeling or confusion such false statements would create. However, whether the truth is finally arrived at by the process of *reductio ad absurdum* or direct reasoning, makes little matter so long as darkness or fog is at length dispelled and the light shines. When that desirable stage is at length arrived at, then we can all look back and smile at our errors and wanderings when in the dark.

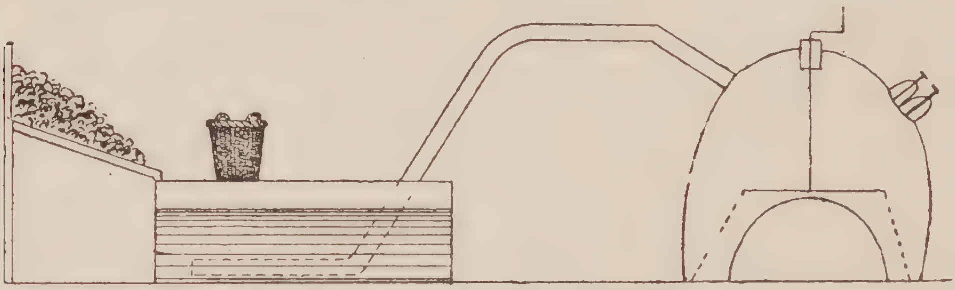
Now on the subject of the physiological action of the materials, products, and surroundings of factories, especially chemical factories, on the workpeople, and the collection of accurate scientific evidence, I may tell you the Germans stand foremost, and therefore you will not be surprised that I quote largely from the observations of German authorities. Of the Alkalis we shall now consider, I shall begin with

Ammonia, and it will be best under the head of ammonia to commence with its sulphate, the commercial Sulphate of Ammonia.

Ammonia Industry.

Sulphate of Ammonia.—In very many branches of chemical industry it has been found by the manufacturer that the method of working which is the most profitable and the most economical is the very one which also secures the healthiest conditions for the workpeople. Let us trace the collaterally improved economic and hygienic conditions of the process for manufacturing sulphate of ammonia since 1868, and I will give you here the result of my own personal experience.

In 1868 sulphate of ammonia was made by heating in wrought-iron boilers or stills ordinary gas-water or tar-water from our gas works along with slaked lime, a pipe from the top of the still leading the gaseous ammonia into diluted sulphuric acid,



Original Sulphate Tank (1857).

contained in an open cistern made of wood, lined internally with sheet-lead. Now tar-water, which by the way was once used as a remedy—perhaps I had better say was a *nostrum*—for a variety of ailments, and taken internally too, may be defined as a watery solution of a variety of ammonium salts, with a small quantity of coal-tar bases, and generally a little film of tar floating on the surface. Chief as to quantity among these ammonium salts, are the carbonate and sulphide. On boiling with milk of lime, especially at first, along with free ammonia, a certain and a considerable quantity of carbonic acid and sulphuretted hydrogen escaped from the acid cistern. The ammonia was absorbed by the sulphuric acid, the vigorous action causing the mixture in the tank to get warm, whilst carbonic acid gas

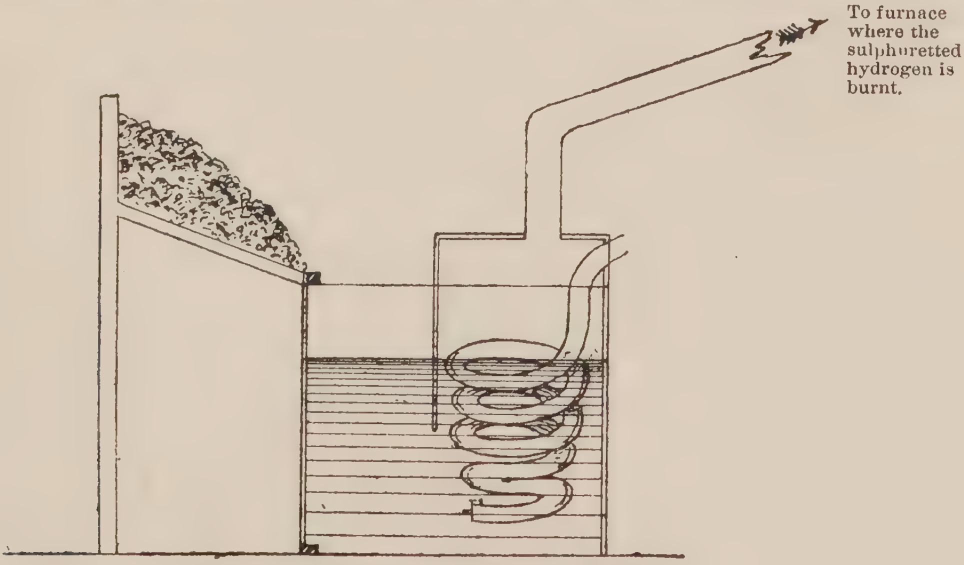
"Gassing" in 1868.

and sulphuretted hydrogen passed off into the air. Sulphuretted hydrogen gas is one of those singular chemical substances which smells worse the more dilute it is, and hence, as you may imagine, it was a difficult thing for the manufacturer to keep out of "hot water" with his neighbours in those days. The factory workmen generally knew how to dodge the fumes, but new hands, or strangers, were occasionally overpowered and rendered unconscious, and I recollect on one occasion a plumber

who endeavoured to repair the leaden side of one of the cisterns during a dinner hour, was found afterwards with his boy assistant lying quite dead by the side of the cistern. Some of you would no doubt like to ask if they would suffer any pain. Absolutely none, I reply; no more than you do in going to sleep. Men who had been "gassed" at the sulphate tank in those early days told me that if ultimately favoured with a choice of deaths, they would not fail to choose that by "gassing" at the sulphate cistern or tank, it was so uncommonly like being overcome by sleep. A man so partially "gassed" as to feel unconsciousness commencing to creep over him would often run ten or twenty paces away before falling, and I never knew or heard of a case where such feeling of alarm had been occasioned as to cause a man to run away for fresh air, in which he did not ultimately fall, and lie unconscious for at least a brief period.

The remedy adopted in the tar distilleries in those days was to lay the man with his abdomen over an empty petroleum barrel, and one man taking his head, and another his heels, they would draw him backwards and forwards over the rolling barrel. This remedy, though rough, was by no means irrational; it was a mechanical process for at once expelling the irrespirable gases, and of restoring normal respiration, and was always effective, except in very bad cases. The after-effects of unconsciousness through this "gassing" simply lasted for the day or over-night; the man feeling, as he would put it, "rather light-headed" for a time. However odourless the carbonic acid might be, the sulphuretted hydrogen mingled with it, and "scenting" it, gave rise to much trouble and many fines for the manufacturer, who at length constructed another kind of sulphate cistern, in which was an arrangement for cutting off the noxious gases from the workmen and carrying them to a

Rough remedy adopted.



Improved Sulphate Tank (1872).

furnace flue, generally the steam boiler furnace. Thus, at all events, the workmen were spared; and I have seen this kind of sulphate cistern in full operation and the still too, under cover, and in the large room of an old cotton factory, in the north. However, the nuisance to the neighbourhood, though abated, still remained, and so the manufacturer's troubles, for sulphuretted hydrogen, mingled with so much carbonic acid, was apt to be carried away still to a considerable extent, unburnt.

Government Inspection.

Ultimately, the Government stepped in, and committed the matter to the care and supervision of the General Inspector of Alkali Works, and he now insists on the removal of sulphuretted hydrogen gas from the "sulphate gases" by means of an oxide of iron purifier, similar in principle to the oxide purifier employed in gas-works. In the meantime, the German Sulphate and Ammonia Manufacturers, Dr. Grüneberg, of Cologne, and Herr Feldmann devised improved stills, by which a certain proportion of ammonia, hitherto lost in the waste liquors and spent lime mud, was recovered, and these inventions far more than covered any expense incurred in the nuisance-abating purifiers, the use of which the Alkali Inspector had enforced. But a direct value arose in these purifiers for the manufacturer, for the oxide of iron therein in decomposing the sulphuretted hydrogen becomes itself converted into sulphide of iron, and this on roasting in suitable shelf-burners yields sulphurous acid, and in the leaden chambers, sulphuric acid, which can then be used over again in producing fresh sulphate of ammonia.

In England both the Simon-Grüneberg and the Feldmann stills are much used, as well as modifications of them.

Present condition.

At the present time, I consider the hygiene of an ammonia and sulphate of ammonia works, under the supervision of the Alkali Inspector, is as perfect for the workpeople as need be. With regard to any injury or danger from ammoniacal gas (ammonia) itself, when we consider that the whole attention of the manufacturer is concentrated upon the most perfect condensation of the gas that is possible, and the most effective storage of the aqueous liquid, and that any annoyance to a workman's respiratory apparatus means loss of money to his master, you may imagine that the master's interests and the man's comfort in that respect coincide with most particular completeness. In short, workpeople in such a properly conducted works and with the best plant, are not exposed to any debilitating effects arising from small escapes of injurious gases or vapours.

Having said this of ammonia works, I may add that just the same remarks apply to the large factories where soda is manufactured by the Ammonia Soda process.

I cannot close my account of the history of sulphate of ammonia making, without telling you a singular accident which occurred in 1870 in a works near Manchester, entirely owing to the neglect of a workman on the night shift. It had been thought in a still larger factory quite possible to distil the gas-liquor and expel ammonia into the sulphuric acid so as to form sulphate without any addition of lime in the still. The smaller factory determined to stop the use of lime and follow the same course, and the night-men were warned not to neglect to keep the fires going regularly under the stills. During one evening, however, the attractions of a public house not far distant proved too much for the night workman, and he left the premises and let the fire burn down under the one still he was in charge of. On his return that fire was nearly out and the pipes were cold. Alarmed at the result of his foolish neglect, he commenced to fire up vigorously. Now what had occurred during the cooling process? At a given period, when ebullition was but feeble, a condensation of ammonium sesquicarbonate took place, vapours of that substance commencing to deposit in the pipes, eventually filling them and choking them up. On re-firing and re-starting the still then, that man was actually heating up a boiler absolutely closed and with no pressure gauge! The final result was naturally a terrible explosion which killed him and another man, and the rent still was carried up in the air over a row of cottages and deposited in a pond about 100 yards off. I may tell you that to dispense with the use of lime was not only a primitive process now never thought of, but a losing game for the manufacturer, since a careful analysis of the residual still-liquors would certainly have demonstrated the presence of an amount of ammonia that should never have been thrown away. Of course the apparatus used was of the primitive type I have already referred to. But the moral for many chemical factory men is as good to-day, and as necessary, as then! Accident thro' workman's neglect.

Ammonia.—In the manufacture of pure ammonia, or *Liquor Ammoniæ*, the health of the workmen is not affected at all, unless by such accidents as are analogous to a case say, like that of the fracture of the fly-wheel in the engine room of a large mill, such for example as the breaking of a carboy of strong ammonia and the accidental inhalation of its vapours. It is a case of loss to the master and pain to the man.

But let us now ask, "What is the physiological action of ammonia vapour?"

The investigations of Dr. Kar B. Lehmann, of Munich, on this subject are most reliable. Those of Hirt seem on the whole quite untrustworthy, so far as estimations of quantity, Physiological action of ammonia.

are concerned. Lehmann shows that there is extraordinary similarity in the action upon the respiratory apparatus of animals, between gaseous ammonia and gaseous hydrochloric acid. In experiments upon himself, this investigator exposed himself for half-an-hour in atmospheres containing 0·20, 0·30, and 0·33 per 1000 of ammonia, and two further experiments of twenty minutes each, in air containing 0·3 per 1000. The following were the principal symptoms:—Respiration strongly nasal, slow and careful; rather strong stinging sensation in the nose, frequent sneezing. The deep inspirations by the mouth, excited during sneezing, caused some smarting in the trachea (windpipe). The eyes tingled so painfully that they could not be kept open, one after the other, long enough to read off a scale divided into half millimetres. Some lassitude and headache, the head becoming flushed, and perspiration excited, although the day was a cool one. Considerable secretion of saliva. Symptoms for the first five minutes especially unpleasant; however, gradually the experimenter grew somewhat inured to the effects. Nevertheless, the continuance in the room was attended with much discomfort, and though a further concentration appeared safe, yet it also seemed as if it would be unendurable. After leaving the room, the smarting in the nostrils and the headache continued for a time, gases were frequently got rid of by eructation, and then the normal conditions of bodily comfort returned. Another person in the room, with 0·3 per 1000 (0·3 $^{\circ}/_{\circ\circ}$) of ammonia, suffered in addition a slight pain in the breastbone, but ten minutes after leaving the room normal conditions returned. Still another person suffered neither the headache nor the sweating, and instead of sneezing, he complained of a painful feeling of swelling in the neck and throat, and also of feeling of great cold in one hand.

Now ammonia vapours are often pretty strong in the purifier house of our gas works, and Dr. Lehmann accordingly determined the amount of the volatile alkali present in the atmosphere of the purifier house of the Munich gas works, when the purifiers were being emptied. On one day the amount was 0·07 $^{\circ}/_{\circ\circ}$, and on another when the odour was even stronger, 0·11 $^{\circ}/_{\circ\circ}$. Such doses, he says, are on the verge of decided unpleasantness. However, it seems that larger quantities of ammonia than this were often present in the case of this gas works, for one of the workmen was suffering somewhat acute chronic *conjunctivitis* (inflammation of mucous membrane of the eye), or some *ectropium* (eversion of eyelids), the cause of which he attributed to his work.

Finally, Dr. Lehmann states it as his belief that with a little

practice 0·3 to 0·5 $^{\circ}/_{\circ\circ}$ of ammonia in the air can be borne a considerable time without sensible injury, and he is of the opinion that quantities of from 1 to 2 per 1000 can be endured for brief periods without injury. In any case, however, quantities over 0·5 $^{\circ}/_{\circ\circ}$ in working spaces where men are confined for considerable periods, are decidedly to be condemned as injurious.

When Hirt therefore speaks of animals that have lived for a day in air containing 100 $^{\circ}/_{\circ\circ}$ of ammonia and are none the worse, and of air containing 40 $^{\circ}/_{\circ\circ}$ as being a respirable and the proper atmosphere to be artificially created for workpeople engaged in "silvering" mirror-glass to protect them from the mercury vapours, then I say such workpeople would be in the position of the proverbial fish in the frying-pan, with a protector who, to save them from the pan, suggests a jump into the fire! Lehmann says he knows indeed of no reliable investigation or data to show that the pouring of *liquor ammoniæ* on the floor of the mercurialising rooms of mirror factories is of actual benefit, but it appears to him actually ludicrous that Hirt should give a solemn warning against tincturing the atmosphere of such rooms with more than 4 to 5 per cent. of ammonia! (Hirt, Gewerbekrankheiten, Handb. der Hyg., Bd. 2, Abth. 4, page 28.)

Lehmann gives some very valuable experiences of chief engineer, Herr Pitzner, formerly a colleague of Prof. Linde, whose ammonia ice-machine is so well known. In bringing this machine to perfection, Linde with Pitzner were engaged for nearly three years, and through faulty stuffing-boxes, &c., and various needs for repairs in the more primitive apparatus, considerable escapes of concentrated ammoniacal vapours took place. No real or lasting injury was ever noticed, and during Pitzner's eleven years' experience with ammonia ice-machines, he never knew of a single death taking place that could be recorded as caused by the action of ammonia. When working with the incomplete machines the workmen were often ailing, but almost invariably with transitory ailments—bronchitis, conjunctivital catarrhs, &c. Of chronic complaints traceable to ammonia vapours, Lehmann could find none; the catarrhs were mostly not of chronic character. Two workmen engaged as above he did not examine. They had been in the business many years, and were perfectly sound and healthy.

Pitzner himself often worked in rooms which he was compelled to leave every half minute or so for fresh air. He suffered from no eye troubles. It seems that nature has provided for such dangers in the case of the eye, for so plentiful is the secretion of tears, that the cornea is preserved thus

from attack. Another observation as to the action during brief periods of strong ammonia vapours is of interest, it is that a tendency to vomit always arises, and sometimes actual vomiting takes place.

Of course now, either in the construction or use of ice-machinery of the kind referred to, scarcely a trace of ammonia is perceptible, so perfect are the adjustments. For the medical expert it is, however, useful to know what the essential tendency of strong ammoniacal vapours absorbed internally, is. It is this: To attack and destroy the more delicate portions of the epithelium, laying bare places in which at once inflammation is set up. The curious thing is, that placed in contact with concentrated ammoniacal fumes, another service of nature prevents such fumes reaching the lungs, a cramp or stricture of the epiglottis taking place. On several experiments by Lehmann, the trachea and even stomach had become inflamed, whilst the lungs had remained intact.

An interesting, although a painful case, of choking with ammonia, and almost to the death, came under my notice in 1867. A boy, who had brought a sample into the laboratory of the works where I was then engaged as chemist, took up a beaker glass half-full of the strongest ammonia, and, thinking it was water, flung the contents full in the face of my laboratory boy and ran out of the room. I entered the room as the first boy left it. My laboratory boy was evidently in a paroxysm of distress; some of the ammonia had entered his mouth, and some his nostrils. He advanced towards me like one in a semi-cataleptic state, the back was unnaturally bent inwards and the abdomen outwards; also owing to a cramp-like contortion of the legs and ankles, he seemed to stagger along on the toes alone. He raised his hands to my face, as I thought to scratch me, but his fingers were bent and cramped, and scratching was out of the question. After this he seemed to sink into himself and collapse, falling to the ground. Of course we sent for a doctor, and did all we could for the lad. I observed no tendency to vomit, but when on the ground, he commenced a singular gyration of himself whilst lying on his side, by the action of his legs and feet. Now it is a singular thing that Lehmann observed just the kind of symptoms I have described, in the case of small animals he had subjected to the action of rather large quantities of gaseous ammonia. Especially the gyratory motion he specifies as characteristic of ammonia. The lad I have referred to lapsed into a comatose state, and was found pulseless by the doctor. Whilst apparently strong cerebral action had been set up, he had also choked through stricture of the epiglottis, which had closed and protected his

lungs. The doctor administered a mixture of warm milk and alcohol, and in an hour the boy was restored to consciousness. He complained of sore mouth and throat, but after lying-up for a few days with a kind of slight bronchial catarrh, he returned to work apparently none the worse for his adventure.

Turning to our great Ammonia-Soda factories, let me remind you that all the movements of skilled engineering employed there, are in the direction of exclusion of the workman from any but traces of ammoniacal gas, for ammonia in that process is looked upon as we regard money stored in a mercantile concern and producing a given rate of interest upon which interest the investors are living. To let ammonia leak away or get lost during its circulation, would be like letting some of the capital sums invested dribble away. The whole genius of the ammonia-soda process is to continually circulate the same ammonia, or as nearly so as possible, and not lose it by leakages, &c. I think I may safely predict that no reason or cause will ever arise for inspecting works and factories for the sake of preventing injurious escapes of ammonia. Ammonia-Soda Works.

Soda Ash.—Whilst upon the subject of ammonia, and before concluding it, with also the ammonia-soda industry, I should like to say that there is nothing in this latter industry that I call injurious or dangerous, in the sanitary sense, in any properly conducted works. Of course, with soda ash, the crude carbonate, which, by the way, in the case of the ammonia-soda process, possesses very little if any crudity—the dust of the ash in packing is no doubt irritating. The irritation is chiefly to the nostrils, and violent sneezing is induced. This result alone is sufficient to compel the workmen to muffle their mouths and nostrils, and in the case of a well defined dust, there is no difficulty then in avoiding the introduction of soda dust into the mouth or throat. I have never known any injury to health to arise in the case of packing ash, even finely ground ash; a man is compelled to muffle up and protect his respiratory apparatus, by reason of the inordinate fits of sneezing induced if any attempt were made to dispense with them. I think we may say that the very solubility and immediate acridity of the fine particles of soda ash, form the best means of protecting the men who handle it from injury to their respiratory organs. Soda ash.

Caustic Soda.—This is the hydrate or hydroxide of sodium, and is obtained on the large scale by boiling the dilute solution of the carbonate with slaked lime, which, possessing greater affinity for the carbonic acid of the carbonate of soda than the soda has, appropriates that carbonic acid, leaving in solution the hydrate or caustic, the insoluble carbonate of lime settling down, and leaving as a clear liquid the dilute caustic, which is Caustic soda.

eventually evaporated down, at increasing heats, until it is brought to igneous fusion. With regard to sanitation, caustic making is as healthy a process from beginning to end as soap boiling or brewing. I will tell you the only accident that ever came under my experience. When the prices of alkali reached a very high figure in 1873, some persons sold up their own businesses, and launched into small concerns for soda making, though without any knowledge of the subject, still less of the elements of chemical science. One such person, whom I assisted chemically for a brief period, set his caustic pots almost quite level with the platform on which the men stood, and insisted on their commencing work without supplying proper lights for the sheds at night. At last one man dipped his foot into strong, hot liquor, and was taken home with a bad burn; tetanus set in after about a week, and the man died. But you see I am only telling you here what might occasionally happen in the case of badly or insufficiently arranged plant, in the way of accident. However, there is no danger now, or probably ever will be again, of alkali prices being such as to tempt strangers to go into the Leblanc alkali manufacture! I shall, therefore, venture to place the simple manufacture of soda ash and caustic, as regards sanitation, on a par with soap making, and indeed, soap manufacturers largely use both soda ash and solid caustic.

Soda—or alkali-waste.

Soda—or Alkali-Waste, and the Recovery of Sulphur therefrom.—In older times, the alkali waste (an insoluble sulphide of calcium, mingled with a little carbonate of lime, cinders, etc.) was thrown out upon waste land, and beaten down as closely as possible. It thus gradually suffered an oxidation process, which resulted in the evolution of sulphuretted hydrogen in the neighbourhood, which meant two things: the loss of the sulphur to the manufacturers, and a nuisance, in the shape of ill odours, to the neighbourhood. However, I must deny that even this state of things affected appreciably the health of workpeople, for I can in this matter talk about my own health, after living and working for some six years in the thick of the vapours of Runcorn and Widnes, in Lancashire, and I simply say that my health was in every particular as good then as it is now that I am living in Hampstead. I do not deny, however, that a stranger coming, say from Hampstead, and pitching his tent in Widnes or Runcorn, or similar neighbourhoods, for the first time, would suffer some nausea, and thus encounter what is described as a general "lowering of the system;" but I do say, that after a short time people become inured, and get the nervous system, shall I say "attuned," to these odorous conditions. In this connection I will indeed add

my own personal confirmation to the statements of Mr. Cooper, of Widnes, Dr. Ballard, the Alkali Inspector, Dr. Robinson and Dr. Mouritz, of Runcorn, as given by Dr. J. T. Arlidge in his work on "*The Diseases of Occupation*," pages 497–498; that, except to workpeople already suffering from lung troubles, the vapours show no ill effects, not even in the intensification of maladies. However, a great revolution has been effected since then, in the introduction of a process for recovering the sulphur from alkali waste, known as the Chance-Claus process. By this process the waste is mixed with water, brought to the state of a cream, and then treated with carbonic acid gas from lime-kilns, so as to set free the sulphuretted hydrogen gas, which is subsequently half-burnt in an ingenious manner, and in an ingeniously contrived kiln, so that whereas in the ordinary way of burning in the air, $H_2S + 3O = H_2O + SO_2$, in this case $H_2S + O$ only gives H_2O, and S is left, and this sulphur is then deposited in a suitable chamber, collected and sold or used as brimstone, or the H_2S can be burnt, and the SO_2 passed into the sulphuric acid chamber, to make sulphuric acid or vitriol.

Recovery of sulphur from soda-waste.

At first, however, nuisances were caused by the new process, which had not been thoroughly brought under control. In the Government Alkali Inspector's Report of the year 1889, he confessed that "While the public and the Inspectors under the Alkali Act may be congratulated on the partial removal of one source of nuisance by the application of the Chance-Claus process, unfortunately that process itself is liable to be the source of a similar evil."

The Chance-Claus process.

This was for 1889, and since then, through the unflagging efforts of the manufacturers, notably of Mr. A. M. Chance, the inventor, and the friendly criticism of the Inspectors, so much improvement has been wrought, that in the last report of Mr. Fletcher, the Chief Inspector, dated 1893, he states: "'There was great difficulty, 'at first,' in preventing the escape of sulphuretted hydrogen, and for about six months before the minor difficulties were overcome, much nuisance was occasioned near the works. *This is now, however*, passed, and the presence of that noxious gas is no longer perceived. The points of danger are now well understood and carefully watched." The last time I was in Widnes and was shown over a Chance-Claus plant there, I could perceive no odour of sulphuretted hydrogen whatever about it. If any friend from Widnes, or Runcorn, or St. Helens, be present, he may ask, "Then, why do we yet perceive occasionally odours of sulphuretted hydrogen on arriving at those towns"? I reply, those odours are from the old heaps of waste of years ago, in which the oxidation is not yet complete.

Physiological action of sulphuretted hydrogen.

However, now we have reached the subject of sulphuretted hydrogen, let me tell you something of the physiological results obtained by Dr. Lehmann, of Munich. He says (Arch. Hyg. 14, 135), as the results of his experiments on the *Toxic action of sulphuretted hydrogen*, he concludes to set 0·7 to 0·8 per million as the limit which must be drawn concerning an atmosphere, the remaining for a few hours in which begins to threaten some danger of injury to health. An amount of 0·15 per million of air appears, even after many hours' duration, not to effect such damage, but from 0·2 per million down to 0·15 is sufficient after some hours, to produce unfavourable symptoms. To give you an idea what these figures mean, let me say that if you go now to Widnes or St. Helens, choose the most fragrant waste heap to be found, set up a tent upon it on a damp still day, when the fragrance is greatest, and after closing the tent door you test the air of the enclosed space, you will not find anything approaching Lehmann's minimum figure, viz., 0·15 per million of sulphuretted hydrogen. Lehmann's figures will no doubt be very useful to Medical Officers and to our Inspectors of Works.

How alkali men have sometimes cooked their food

Use or custom is said to be "second nature," and I may tell you I have seen workmen cook a chop and boil up their tea by scooping a hole in the side of a waste heap partly on fire, until a red-hot portion was reached. The food was placed on a clean spade and the latter pushed into the hole and kept there till the chop was grilled and the tea boiled. The hole thus served as an oven, and spite of a slight odour of sulphurous acid and a tincture of sulphuretted hydrogen, chop and tea respectively, were at length eaten and drunk with appetite and relish.

Sulphurous Acid.

This gaseous substance (sulphur dioxide, popularly known as "fumes of burning sulphur") is principally employed for manufacturing sulphuric acid or vitrol. It is also used in bleaching wool, silk, and straw, and in the sulphite wood-pulp process. It is produced in the purest condition by allowing sulphur to burn in the air in suitable kilns, the oxygen of the air supplied by a slow draught, combining with the sulphur during combustion to evolve sulphur dioxide. A cheaper source of this gas is iron pyrites, the bisulphide of iron, which easily parts with one-half of its sulphur, and at a red heat and in presence of the oxygen of a sufficient supply of air, with the final half as well, and leaving oxide of iron (ferric oxide). If the iron pyrites be of a cupreous nature, so much the better for the manufacturer, as the copper left with the oxide of iron is easily extracted in a subsequent process by roasting the ground

ore with common salt at a dull red heat, and then lixiviating the cooled charge in vats, with water and dilute hydrochloric acid. The green copper liquors are treated with scrap iron in separate precipitating vats, when the iron dissolves and the copper is precipitated as a metallic powder to take its place.

In making sulphuric acid, the kilns, whether brimstone kilns or pyrites kilns, are so arranged that their flame or hot gas passes through an additional kiln in which are cast-iron pots containing nitrate of soda, or Chili saltpetre, mixed with sulphuric acid, which must be in slight excess. The heat causes nitric acid to be driven off, which the sulphuric acid has already set free from the nitrate of soda, and its vapours mingling with those of the sulphurous acid not only assist the oxygen of the air in oxidising this sulphurous acid to sulphuric acid or vitriol, but convert that oxidising process, otherwise a very slow one into a quicker, and also into a continuous process. Still the process is a comparatively slow one, and hence large spaces are required to accommodate such immense volumes of gas, and for this purpose large oblong chambers are built of light woodwork and lined internally with sheet lead, which dips into a bottom constructed like a huge dish of stronger sheet lead, so that the whole is something like a large tea-cup inverted in its saucer, but prevented by outer supports from resting its weight and mass quite on the bottom of that saucer, or like a huge oblong shaped gasometer which does not rise and sink, but is always as high up as possible. You will say, "yes, but the gasometer is luted at the bottom in water." I say, "just so," and the sides of the Vitriol chamber also dip into vitriol always present at a sufficient depth in the dished bottom so as to lute the bottom of the "*curtain*" of lead, as it is called. Just at the place where the sulphurous and nitrous acids enter the chamber, steam is also turned in. Inside those chambers a shower of rain is always falling upon the bottom and running down the sides, and that rain is sulphuric acid—it is a vitriolic shower. At the end of the chamber system is a leaden tower called the Gay Lussac Tower, the purpose of which is to catch and retain the costly nitrous fumes—a red choking vapour which would certainly injure health, but which the manufacturer has no intention whatever of allowing to escape. Gay Lussac discovered that cold strong vitriol easily dissolves nitrous fumes (nitrogen trioxide), and from this discovery arose the device called the Gay Lussac Tower. It is packed with hard cokes, and downwards from a cistern above, strong sulphuric acid trickles in all directions. This shower meets the ascending gases from the last of the system of sulphuric acid chambers, and absorbs all the nitrous fumes from them. Strong vitriol thus charged with

Manufacture of sulphuric acid.

nitrous fumes really forms a compound called nitro-sulphonic acid, which is easily decomposed by water or dilute vitrol, especially if hot, the red nitrous fumes being set free for use over again. Now this description, though incomplete, will suffice for my purpose.

Hygienic conditions.

We have brought together in this remarkable process several acids and acid vapours, and so we will study their hygienic bearing on the workpeople together. Do not think that sulphuric acid is only made by the Leblanc Alkali manufacturer, manure manufacturers, tar distillers, dye and colour makers, indeed all who want much sulphuric acid, often make it for themselves.

The question to which I now hasten is this: Is the manufacture of sulphuric acid injurious to the health of the workmen engaged? I answer without hesitation, "*No, it is not.*" It is not the object of the manufacturer to build expensive plant to generate gases and vapours, afterwards to be wasted by leakage into the air, a proceeding which, besides loss of money, would mean stoppage of his process by the Alkali Inspector, with a probable fine on a repetition; but it is his object to manufacture sulphuric acid, and so to confine and utilise to the utmost those noxious vapours engaged in its formation. The small quantities of sulphurous acid you may sometimes smell in Vitriol works are distinctly not injurious; that I say after a twelve years' experience in such factories. But there are special occasions, which however only rarely occur, when great care is necessary, and when the men perhaps need some authoritative protection from their own ignorance and often downright obstinacy. Such occasions are the cleaning out of the chambers, or of a Gay Lussac Tower.

Dangers in cleaning chambers and Gay Lussac Towers.

Let me say, at once, that when accidents occur through inspiring too much of the gases left in a chamber or a Gay Lussac Tower, to be cleaned out, the *first cause* is generally attributable to men entering too soon. But the *second cause* is not usually the sulphurous acid vapours present, but the residual nitrous fumes, and I think I cannot do better than direct attention to this fact. There is a number of noxious gases, all of which, if not too largely admixed with air, at once make you aware of the peril of your position in respiring them by certain unpleasant symptoms, but nitrous fumes form a notable and an insidious exception. Hence, even in the admirable book of Dr. Arlidge, I notice that the occasional accidents occurring on cleaning out the chambers, are evidently attributed to the sulphurous acid present. No doubt, as to odour, the sulphurous acid completely masks the much smaller quantities of nitrous gases, but there lies the danger.

To convince you, in the first instance, that sulphurous fumes, of course in very small proportion, are by no means so insidious or injurious as they have sometimes been represented, I would merely remind you that in times of cholera and other epidemics, you may expect, if need be, to be disinfected with burning sulphur fumes, which are sulphurous acid, and that sulphurous acid in a liquid form, and in the form of bisulphites, forms a most valuable antiseptic and disinfectant. But I will give you also the results of the experiments of German investigators, and especially of Ogata. Ogata, with several others, found that 0·5 to 0·7 parts of sulphurous acid, per 1000 of air, act seriously upon small animals, such as rabbits and guinea-pigs, in two hours inducing incipient destruction of the cornea, bleeding of the lungs, emphysema (distension of tissues with gases), &c., 2 to 3 per cent. sufficing to kill the animals in a few hours. Lehmann draws attention to the fact that Hirt's figures for sulphurous acid are 150 to 200 times higher than these, and since Hirt is an authority known in England as well as Germany, I beg to warn sanitarians that, whilst symptomatically Hirt is no doubt correct, Lehmann shows that most of his figures are terribly in excess of the truth.

Physiological action of sulphurous acid.

This simply means that a totally irrespirable atmosphere is sometimes put down by Hirt as one that a man might safely pass a day in! But an atmosphere anywhere in a sulphuric acid works, which contains 0·5 part per 1,000 of SO_2, could never be found under normal circumstances.

It may be interesting to know that the atmosphere of the Metropolitan Underground Railway tunnel at Gower Street is sufficiently charged with sulphurous acid to make that tunnel act something like a sulphuric acid chamber. Droppings from the roof which taste acid are continually falling on to the platform, which is whitened and corroded by the weak vitriol, which these droppings certainly consist of. If you ask me as to injury to health caused by such an atmosphere, I say at once I don't believe there is the slightest, except in the case of delicate or diseased lungs. I don't know what escape there is from the conclusion that that tunnel is efficiently and cheaply disinfected against cholera and influenza, though I certainly deprecate the presence of the solid particles of carbon of the smoke and any carbonic oxide of the fuel gases.

Sulphurous acid in Underground Railway tunnel at Gower Street

But I spoke of the insidious nature of the mixed sulphurous acid and nitrous vapours of the Vitriol Chambers and Gay Lussac Tower. This character is almost entirely due to the nitrous vapours. In the *Chemische Industrie*, 1889, p. 317, there is reference to a workman who died after cleaning out a Chamber through the nitrous fumes, but a *post-mortem* proved that he had

Gases of chambers and towers.

a very diseased heart. A case is also given in the *Chem. Ind.*, 1892, p. 284, of the death of a man who had assisted in cleaning out a Gay Lussac Tower in which stoppages of draught had occurred. Although the tower had been, as was thought, thoroughly freed from acid and nitrous vapours by washing out with hot water, running down soda solutions and several days' airing, and the workmen, previous to their descent into the tower, had bound wet sponges over their mouths to act as respirators, nevertheless, one of the men, known as a sickly and weak man, was soon so affected by the dilute nitrous vapours, that after walking about a mile of his journey home he could go no further, and he died before the following morning. Yet the other workmen of stronger build had worked for hours in the same atmosphere without apparently any injury whatever. In such cases it is recommended that special respirators should be furnished, with tubes, and a supply of air from outside. The best form of respirator for such a purpose as recommended by German authorities is that of König, known as the Patent Respiration Apparatus, to be obtained from Gustav Kleemann, Engineer, of Hamburg.

Nitrous fumes form an insidiously noxious gas, and I must explain what this means. If a workman, or even a chemist, unaccustomed to its mode of action, try to judge of the influence of air mixed with a small proportion of it upon their respiratory organs, by closely observing how they feel whilst respiring such atmosphere for a short time, they may find themselves woefully deceived. To put it briefly, one of the principal symptoms, and that most characteristic of nitrous fumes, is the peculiarly deferred but alarming *dyspnœa* that after a time sets in. But it is *dyspnœa* of a special order, for whilst the inspirations are comparatively unimpeded, the expirations become more and more difficult and painful.

You will be astonished when I tell you however that the vapours of nitric acid, like those of hydrochloric and sulphurous acid, are not to be compared with those of nitrogen trioxide (red nitrous fumes) for danger, nor is that danger to be found except very seldom in either alkali works or nitric acid factories. There is a case given in a German report from the *Chem. Ind.* 1892, p. 283, and it is typical of perhaps the only kind of serious occurrence in our modern nitric acid works. A workman who had the job of filling a pressure-cistern in the open air with an acid for nitrations, upset the vessel he was carrying, and apparently fearing a severe reprimand, he endeavoured to remove the spilled acid by washing it away with water, without saying anything about the mishap. He trusted that the vapours in the open air would become so quickly diffused as to

Accidents in nitric acid works

become uninjurious. Such an acid would, however, generate volumes of nitrous fumes in contact with all organic matter it came in contact with. The man died in nineteen days after, from the effect of the fumes. For this class of work and such emergencies, that factory had respirators for the men, but what could a firm do in such a case as this?

Vitriol chamber plumbers.

Before leaving the subject of Sulphuric acid manufacture and going on to Nitric acid manufacture, towards which I have been steadily advancing, let me say a word about the Vitriol chamber plumber. Dr. Arlidge in his work, page 463, says, "The evils of lead are more severely felt by the plumbers, who find constant work in making and repairing pipes, funnels, and chambers, and are exposed to the fumes of the solder they use as well as to the metallic lead itself." But the use of soft solder for cementing sheet lead is out of date, and plumbers now always use strips of soft lead, which metal is used with a blow-pipe flame, somewhat as sealing-wax is in sealing a parcel. I do certainly not believe the plumbers suffer so much from lead fumes, for they need no such high temperature for their process as would cause appreciable lead fume, but they will use in their hydrogen gas-generators exceedingly impure spelter, and impure sulphuric acid, and both of these containing arsenic, they thus obtain hydrogen in their blow-pipe apparatus, containing considerable quantities of arseniuretted hydrogen, which must be injurious. I have myself pointed the false economy of this to them, but plumbers are rather difficult persons to convince of the errors of their ways.

German rules in cleaning Gay Lussac Towers.

In conclusion of this subject of sulphuric acid manufacture I have just learnt that the German Government has issued certain directions or prescriptions with respect to the discharge or clearance out of the packing of Gay Lussac Towers in sulphuric acid works in Germany. The document is headed, "*Besondere Unfallverhütungsvorschriften für das Auspacken von Gay Lussac Thürmen.*" These directions are recognised and passed by the Imperial Insurance Office, and were printed in the *Reichsanzeiger*, of 27th November last. Let me say that the German Chemical Industries are represented in Berlin by special committees, and I understand that any regulations proposed by the Imperial Government are submitted to these committees before being passed, and once passed they have to be adhered to. Thus the manufacturers practically control, to a great extent, and under a wise Government supervision, their own affairs, and those matters relating to the health of their workpeople. I will now give you the recent German rules with regard to the Gay Lussac Towers.

A. Precautions and Directions for the Employer of Labour.

1. Before beginning to clear out the towers (Gay Lussac), which must only be done under supervision, every connection of the Gay Lussac Column with the chambers and other apparatus, must be cut off.

2. The Gay Lussac Tower still connected either directly with the chimney, or indirectly through the medium of an intervening Gay Lussac Tower, so that the through-draught is maintained, is now washed out, first with sulphuric acid and then with water or steam, until the exit washings only show a specific gravity of 3° Baumé.

3. After this washing-out, the connection with any intervening Gay Lussac and the chimney must be cut off, and the Gay Lussac to be cleared out must be closed up gas-tight. Then, where it is possible, a connection of the Gay Lussac with a chimney or a mechanical ventilator is made, and is maintained throughout the operation of clearing. If the tower is to be emptied from below, then exhaustion from above, with closed cover, is to be effected; if from above by descent into the tower, then exhaustion from below must take place. In the latter case the cover of the tower must be removed. If exhaustion be impossible, the cover should be removed and one large hole should be made below. Only after the tower is sufficiently freed from noxious gases should the clearing out of the packing materials commence.

4. Towers packed with coke, or similar material, should be cleared out from the outside. In the case of high towers, or towers with several internal arches, arched supports, or gratings, several holes at various altitudes in vertical line from above downwards, should be made following the progress of the work, or the emptying process is to be effected step by step ("etagenweise"). Stone, or such like packings, are to be removed by the workmen by passing them out by hand, or hoisting them out by suitable winding-gear. All the packing material is at once to be carried out of the building, *i.e.*, out of the neighbourhood of the Gay Lussac Tower. The workmen should, according to necessity, or, at all events, expressed desire, be at once absolved from further continuance in the work.

5. The workmen should be supplied with good mouth sponges (as respirators), respirators, and proper coverings for their hands, such as india rubber gloves, hand wraps, &c.

6. Before getting out the mud accumulated at the bottom of the Gay Lussac, water should again be caused to play upon it and be stirred well up amongst it from outside. If nitrous

fumes arise, the liquid must be removed from outside, and the stirring up with water continued.

7. Workmen known to be affected with lung or heart affections, ought not to be employed in any of this clearing-out process.

8. Every manufacturer is directed to make known these "Measures of precaution against Accidents" *(Unfallverhütungs-vorschriften)*, by a printed notice set up in a suitable place in the factory. Besides this, these precautions must be impressed upon the workmen, and the dangers of the work be made clear to them, before they commence operations.

B. Precautions and Directions for the Workmen.

9. If, during the clearing out process by entering the tower from above, and thus operating, nitrous vapours in large quantity are generated, the workman must at once leave the tower and acquaint his overseer or superior with the fact.

10. Workmen affected in heart or lungs, who are employed for cleaning out Gay Lussac Towers, are bound to communicate such fact to their overseer.

C.

11. Here follow a few penalties, the proceeds of which go to the Workmen's Sick Fund, in case of disregard of the rules prescribed as above. A member of the Society has to pay double subscriptions for his omission, whilst an insured person pays, for each offence, some penalty not exceeding 6 M (six shillings).

Probable effect of stringent military discipline on chemical workmen.

As I have already said, during all my entire connection with alkali and sulphuric works, I do not remember a single fatal accident in clearing out chambers or Gay Lussac Towers, through inhalation of nitrous fumes. We must also observe that all the men in Germany, workmen and others, are soldiers, and the workmen class are those who will have a lively recollection of the "*Unteroffizier*," or otherwise of the stringent military discipline conveyed in that single word, unquestioning instant obedience demanded, &c., &c., and it may be that such workmen have been ordered heretofore to clean towers and chambers by foremen still mindful of the office of *Unteroffizier*, and the men without word or question, have exposed themselves to the gravest perils, which in English factories *could not thus happen.*

Nevertheless, the precautions mentioned are good, and what of good there is in them I am convinced our friends, the British Acid makers, will at once recognise. So far as I recollect, the vital portions of these regulations are already observed in this country.

Nitric acid: manufacture and uses.

Nitric Acid: Manufacture and Uses.—It is not seldom the case in the chemical industries that whilst sanitary difficulties or dangers do not specially arise in connection with the manufacture of a particular chemical, they may arise subsequently in the use of it. Nitric acid may be placed in this category.

The reason is not difficult to find. (1) The particular substance to be made must be condensed, restrained from escape in any form, for it has to be turned into money, and all skill and delicacies of appliance are, as it were, concentrated upon this object, and so too a maximum of experience is gained. (2) Then, the modes of application by users of the substance will mostly entirely differ from those of its preparation; and (3) in the application, the substance may be chemically decomposed, and then give rise to decomposition-products—which we designate by-products—that may be more noxious than the original substance used.

Proposed classification of noxious gases.

After a good deal of thought on the subject I have come to the conclusion that it may be very hard both upon the manufacturers and the men, to use one term, such as "*Noxious gases or vapours*" indiscriminately for all irrespirable gases; for whilst the accidental inhalation of a certain amount of one gas or vapour, *A*, may produce symptoms which are transient, or which will at once serve as a direct evidence to the person affected, of its dangerous character, another gas or vapour, *B*, may not do so, but induce slighter symptoms at first, which become aggravated later on, even when the arena of mischief has been abandoned for some time; whilst a third gas, *C*, may speedily induce narcotic symptoms, like the gas from the old sulphate of ammonia plant. Thus I should be inclined to separate such vapours and gases hygienically, and classify them as

GROUP 1.—*Non-irritant irrespirable gases*, such as nitrogen and carbonic acid.

GROUP 2.—*Irritant noxious gases*, such as hydrochloric acid, sulphurous acid, nitric acid, ammonia, chlorine, bromine and iodine vapours.

GROUP 3.—*Insidious irritant noxious gases*, such as nitrous acid (nitrous fumes).

GROUP 4.—*Insidious non-irritant noxious gases*, such as bisulphide of carbon, carbonic oxide, and sulphuretted hydrogen.

I should thus consider group 2 as the least dangerous, since giving immediate and adequate warning to the senses; whilst groups 3 and 4 are the most dangerous, as most immediately deceptive to the senses.

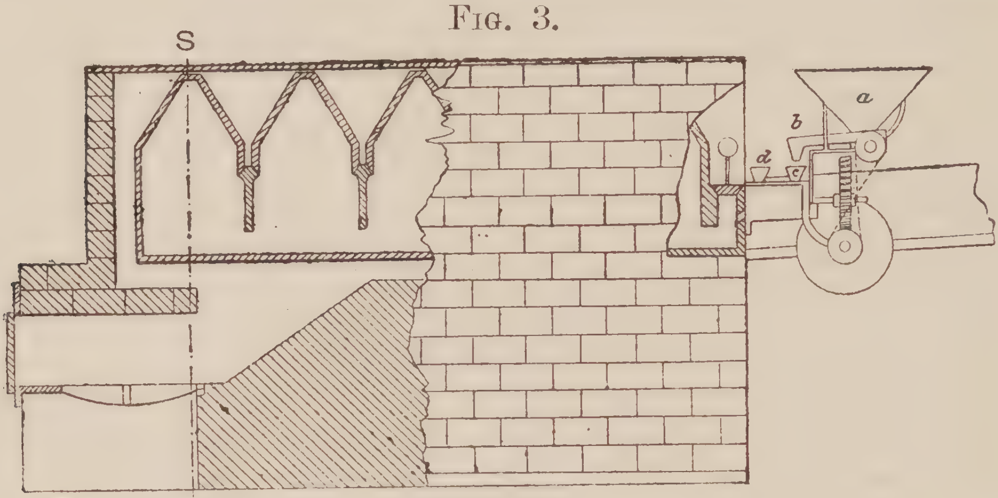
I shall say little about the nitric acid manufacture. In order to make a comfortable profit the manufacturer must

condense the vapours, and not lose them to the detriment both of himself and his workmen. The older cylinder plant, as formerly worked, presented most danger of slight escapes in the preliminary mixing stage of the nitrate of soda and sulphuric acid, but very little of such danger is presented in the perfect apparatus now set up, and connected with excellent modern condensing arrangements. I have recently visited a factory where an admirable continuous process is at work for making nitric acid, and I should like to make as clear to you as mere words can do, what this apparatus and process are like, and the advantage of continuous working when possible. The apparatus and process are the device of Mr. Manning Prentice, of Stowmarket, and he kindly showed them to me in full operation, and answered all my questions. The older and well-known nitric acid cylinders require opening and closing, and charging with materials, and discharging of the crude bisulphate of soda, and though with care, and with such admirable modern improvements, as, for example, the Guttmann apparatus with Lunge Rohrmann condensor, or similar plant, most perfect condensation may be effected, yet a continuous process (always supposing equivalent economy), with continuous automatic feeding-in of materials (nitre and sulphuric acid), continuous mechanical firing, with a constant and even evolution of acid vapours and acid, and continuous and steady out-flow of liquid residual bisulphate of soda, must always from the hygienic point of view be considered the most advantageous. The drawing annexed will illustrate the apparatus of Mr. Prentice, with its agitated charging funnel (*a*), delivering in a thin stream at (*b*) the powdered nitre into a smaller lead funnel (*c*), which leads direct into a mixing chamber, and thence into the still. Another funnel (*d*) receives a constantly flowing and thin stream of sulphuric acid, which only meets the nitre inside the small mixing chamber, and under cover of the still. The mixture constantly generating nitric acid vapours in the hot still, flows on in zig-zag fashion from one compartment of the still to the other, towards the fire, and so that mixture becomes continually hotter. As it reaches the fire-end of the apparatus it consequently contains continually less and less nitric acid, and the residue on emerging at (*s*) is bisulphate of soda. From the first compartment, with its outlet (*e*), a weaker nitric acid is obtained than that obtained at further outlets (*f* and *g*.) These outlets are connected with separate condensing pipes, and furnish very constant acids; the less condensable fumes pass to a small Gay Lussac coke tower, where they are absorbed by a down-flowing spray of strong sulphuric acid. The fire-place is an ingenious one; such, that by a well regulated

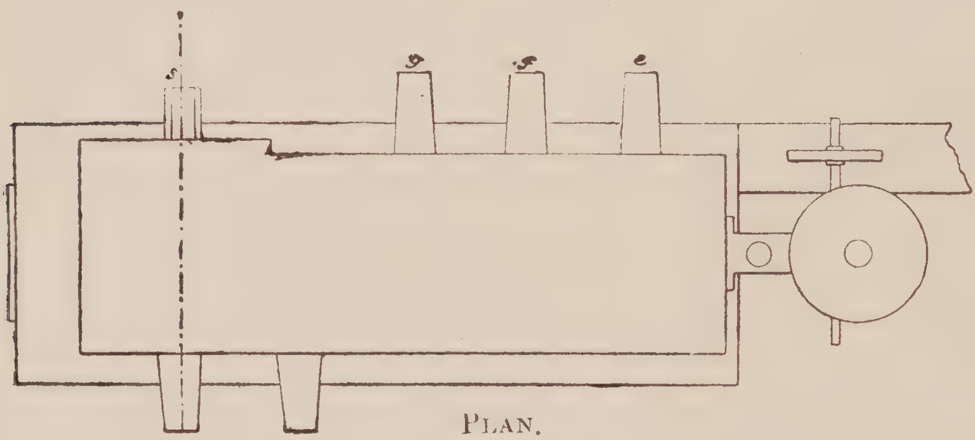
Continuous nitric acid process.

draught and mechanical stoking arrangement, as nearly as possible a constant heat is maintained. The whole apparatus

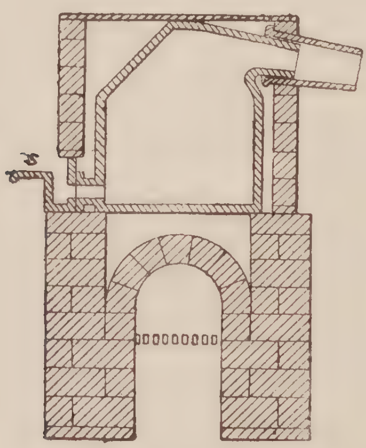
Fig. 3.



Elevation.



Plan.



Section at S S.

is under cover, and the little fume I could perceive, only came from the receiver, containing the manufactured acid, ready to be drawn off.

Nitric acid fumes.

In a nitric acid works, as my friend Dr. C. Otto Weber says, "the workpeople may be exposed to the vapours of nitric acid and nitrous acid. To the former by escapes or accidents, to the latter by accident. Nitric acid vapours form an irritant noxious gas, which gives immediate and full warning to the senses, and so I do not regard it under normal working conditions as dangerous, but nitrous acid is both insidious and deleterious. It is a red gas, and its fumes are always abundantly generated when nitric acid comes in contact with organic substances through some accident. Take the usual case in a nitric acid works. A man breaks a glass carboy of nitric acid, which escapes into the straw of the hamper in which it is packed." Volumes of nitrous fumes escape around. The workman can easily beat a retreat, but not unfrequently, though against the rule, he may desire to hide the consequences of carelessness, and remain on the spot endeavouring to sweep up the spilled stuff. His lungs and life in such a case are in immediate peril, and I will try to explain how. The smell of the fumes is disagreeable rather than pungent. A slight choking sensation ensues on inspiring the mixed air and fumes, with a decided fit of dyspnœa if a little strong gas assail the nostrils. However, for a time the man gets over these symptoms by running away and breathing a little fresh air. After, say a quarter-of-an-hour, during which slight dyspnœa and tightness in the chest are felt, accompanied with nausea, new and alarming symptoms set in, of which I can speak from personal experience. These are as if a valve had been introduced into the throat, allowing tolerably free though spasmodic inspirations of air, but gradually closing against expirations. This at length becomes very alarming, and if presence of mind be lost may lead to violent coughing, and then vomiting, accompanied by swelling of the body. Blood may even be vomited in such cases. Such accidents as these, I may say, place the masters in almost the same peril as the men. But in processes where nitric acid is used for oxidising purposes, unless special draught and condensing arrangements are fixed up, the men are undoubtedly exposed to much peril.

Accidents in nitric acid works producing nitrous fumes.

Of course the accident of breaking a nitric acid carboy may occur not only in a nitric acid works, but also in the other factories where such acid is conveyed. In such other factories this acid is mostly used for oxidations, and in these, nitrous fumes are liberally disengaged. Examples of them are, the manufacture of the so-called "nitrate of iron liquor," of stannic chloride, in the oxidation of "white paste" (ferrous-ferrocyanide) into prussian blue, in the manufacture of all nitro compounds, &c. A manufacturer informs me that in some small works at

Oxidation and nitrating processes, and their dangers.

the present time only insufficient means exist for the removal and condensation of this dangerous gas, and that he recollects several cases in which inhalation of strong nitrous gas by workmen led immediately to fatal results. In two other cases the men succumbed on pneumonia supervening.

Nevertheless, let me say here that I have known many cases in which I greatly sympathise with the small manufacturer, who starts with the most humane intentions towards his employés, and necessarily must exert great economy to make a profit. He is often put to ridiculous and unnecessary expense by a certain class of inspectors of machinery and apparatus, who in very ignorance insist on vexatious and trivial, but costly, alterations of the plant and so squander the man's money fruitlessly, and leave him unable to effect for the time additions which might greatly improve the sanitary conditions of working for his men. The manufacturer would hail with delight a substitution of the visits of the inspector who is a scientific man, such as, *e.g.*, the inspectors under the Alkali Act, but they are very averse to those of the ignorant and unsympathetic faddist, who merely worships his own petty authority.

Action of nitrous fumes on vegetation.

In large works where nitrous fumes are given off in more or less continuous processes, the recovery of this gas, by means of a smaller or larger Gay Lussac Tower, is a matter of economic importance. Dr. C. Otto Weber informs me of a curious fact which he has observed. It is this. Although nitrous gas has such a deleterious action upon living organisms, plants and trees are remarkably indifferent to it. I may remind you too that in the case of hydrochloric acid vapours, the sensitiveness lies just in the inverse direction, minute quantities stripping the trees and killing plants, whilst animals with a little practice can breathe moderate quantities of it. We have thus an inverse sensitiveness to the two gases in plants and animals. Dr. Weber tells me that he recollects that a "nitre shed" in Silesia (Verein chemischer Fabriken) was surrounded with a remarkably fine set of trees. In the shed mentioned the manufacture of nitrate of iron liquor was carried on, and frequently red clouds of nitrous fumes escaped and spread right amongst the trees, but only one of these, which almost overhung the short chimney through which the vapours passed, showed a few branchlets bare of leaves. The remainder of the tree, with all the others, exhibited not the slightest sign of injury, although this factory had been at work for sixty years.

Inverse action of hydrochloric acid.

Dr. Weber says of the manufacture of nitric acid itself, "Nitric acid vapours very seldom escape into the atmosphere of the factory." He only knew of such an occurrence when one of the condensing tubes from the muffle to the condensing plant

had become fractured. He confirms my statement as to the perfection of the best modern plant. He says, "Such escapes very rarely occur now, owing to the very superior quality of the earthenware tubing for condensers now produced. But at one time such accidents were very common, and the heavy vapours of nitric acid quickly filling the room at once acted upon the respiratory organs of those present, and compelled them to beat a hasty retreat. The symptoms produced after an inhalation of the dilute vapours were quite similar to those produced by hydrochloric or sulphurous acid. Only when a workman exposes himself repeatedly to these vapours as, for example, in the attempt to draw the fire from the furnace after rupture of a tube, a severe affection of the respiratory organs can occur, no doubt as with hydrochloric acid and chlorine. At the present time, the stoke-holes of nitre furnaces are mostly so arranged as to be inaccessible to any vapours caused in the working of the process, either incidental to it or purely accidental." Dr. Weber adds, "As far as vapours are concerned in the nitric acid manufacture, I have no hesitation in saying that it is not so much nitric acid as nitrous acid fumes that have to be guarded against." However, in manipulating liquid nitric acid, especially the new workmen, need to be informed of its instantly destructive action on the skin, burns and ulcers being formed. These wounds heal slowly and often cause much suffering if at all severe. It is greatly to be recommended as a safeguard against such burns and corrosions that a moderate supply of vaseline be allowed to the men, so that they may keep their hands well greased. Vaseline is inert to nitric acid and resistant to liquids, but the mistake should not be made of substituting animal or vegetable greases, which are attacked by this acid. Dr. Weber remembers that the attempt was once made in Austria to replace the fragile glass carboys, used for the conveyance of nitric acid, by strong earthenware jars. The dangers of breakage were thus greatly diminished and the railway companies willingly carried the acid packed in these vessels at reduced rates of freightage. However, the weight of the jars was so excessive in comparison to their capacity, that in spite of the reduced rates, the carriage in such stoneware proved too costly.

Vaseline, to protect skin from burns.

Hydrochloric Acid.—Hydrochloric acid is to-day the most valuable product of the alkali manufacturer by the Leblanc process, though at one time it was a most troublesome by-product. It represents the sole advantage at the present time which the Leblanc process possesses over the ammonia soda process, for it is the source of the valuable chlorine gas, which duly combined with lime and oxygen, gives bleaching powder

Hydrochloric acid.

or chloride of lime of commerce, used both for bleaching purposes and for disinfection. The first step of the Leblanc process consists in the treatment of common salt with sulphuric acid in cast-iron pans or pots connected with long blind-furnaces. Over the pots, dome-shaped arches are built surmounted with a short shaft soon turning at right angles in the direction of tall flag towers, packed with hard cokes, and down which water is kept trickling. From the short shaft over the salt-cake pot, a line of earthenware pipes proceeds and enters at the foot of the flag towers, first as a rule dipping into flag cooling cisterns. The gas from the furnace into which the half decomposed salt is pushed from the pot by the workman, is led into the towers by another line of pipes. In these towers a solution of the hydrochloric acid gas from the pots and furnaces is produced, that gas being very soluble in cold water. Thus, liquid hydrochloric acid is formed.

Gaseous hydrochloric acid is also produced in the Hargreaves' process, by passing sulphurous acid gas (sulphur dioxide) along with air over heated cakes of common salt, whereby these cakes are converted *in situ* into sodium sulphate, and hydrochloric acid gas escapes and passes on to the flag condensing towers to form liquid hydrochloric acid. The vapours of hydrochloric acid in anything approaching the concentrated form are corrosive and very irritating to the mucous surfaces and respiratory passages, more concentrated still they are quite irrespirable. In minute quantities in the air, though very destructive to vegetation, I must entirely dispute the statements so often made, that this gas (except in the presence of already existing lung disease), is injurious to health. In my own case I have invariably found as the principal effect, a wonderful whetting of the appetite for food. Of course minute quantities of free hydrochloric acid occur in the gastric juice, but whether there is any connection here I cannot say. Nevertheless, the fact remains.

Hydrochloric acid gas an appetiser.

Whilst resident in Manchester I used to visit with my classes in Chemical Technology, year by year, the Alkali Works of Widnes and its neighbourhood, and I observed invariably, after consulting the students who accompanied me, that the concensus of opinion was that the appetite was greatly increased. Pictures have also been drawn of the woes of the salt-cake men exposed to the vapours of hydrochloric acid, or as it is called, "salt-cake gas." These are mostly exceedingly overdrawn. For sore finger-tips and exposed parts, vaseline should be used, or rather, the parts should have been protected with vaseline, which is inert to hydrochloric acid gas. Whilst I have observed no cases such as have been pictured, I will tell you what I have seen, for years together, practised in the Lancashire and

Cheshire Alkali Works: Women of the poorer classes, and even of the tradesman class, used to bring their infants troubled with whooping-cough, sometimes called "chin-cough" in the north, and beg to be allowed to carry them into the salt-cake sheds when the charges were being drawn. The inhalation of small quantities of hydrochloric gas was regarded as a specific against whooping-cough. If absolutely no result followed such administrations, or if the complaint became on the contrary aggravated, it is not likely such a practice would be continued from year to year; but I have been assured by parents that the beneficial results were most marked. Certain it is that women accompanied by small children, and often carrying infants in their arms, regularly bring their husbands' afternoon meals into the salt-cake and black ash sheds, and usually wait until the meals are over before returning, regardless of the vapours issuing from iron barrows full of freshly drawn salt-cake, or being filled with the material drawn from the furnace. Of course, they take care to keep to the off-side of acid vapour. The men themselves, when drawing the charges, are well bandaged around the mouth and neck. I like the German plan of using as a rough respirator a piece of damp sponge bound over the mouth, and I would recommend it for a trial.

Continuous hydrochloric acid processes.

I have already pointed out the sanitary advantages of continuous and almost automatic processes and apparatus for the preparation of ammonia and nitric acid, and also that, as such improvements are made, the profit to the manufacturer and the comfort to the workmen increase *pari passu*. You will naturally ask if there are similar methods for making hydrochloric acid. I at once reply, Yes; certainly there are. There are the Jones & Walsh and the Mactear revolving furnaces, in which salt is continually charged in through a hopper in one place, vitriol run in through a pipe, and agitation caused by either revolving scrapers, or a revolving bed with fixed scrapers. Whilst salt-cake (sulphate of soda) is continually discharged at its proper outlet, hydrochloric acid continually escapes and is drawn by the chimney draught to the flag towers for condensation, to form liquid hydrochloric acid. But the most beautiful and sanitary process to this end is that of Hargreaves, a fine plant for which, is at work a tthe factory of the Alkali Union, Ltd., known as the British Alkali Works, in Widnes, which is carried on on such a gigantic scale, and worked in such gradual detail, as to constitute a veritable continuous process, though in its details it is intermittent.

Physiological action of hydrochloric acid.

Let us now hear the results of Dr. Lehmann's physiological experiments with hydrochloric acid gas. But here, at the outset, I must again quote Lehmann on Hirt's researches, and the

figures he adduces for what he considers permissible quantities, or insignificant quantities of such gases as ammonia, sulphurous acid, and now hydrochloric acid. Says Lehmann, "Woe to the workmen! who should be in a works in which such quantities of those gases contaminated the air." I lay stress on this matter—firstly, because many of our medical men, physiologists and sanitarians, in this country have quoted Hirt, and seem to rely on his statements, mostly correct as to symptoms, but wrong as to figures; secondly, because I recognise a great possible wrong done to our manufacturers if those figures be relied on, in leading physiologists and others to pronouncements on the characters and sanitary properties of these gases in air, that may be extremely wide of the mark, and, thirdly, I could conceive it possible that, relying on those figures, some might quote them as indicating that our Government Alkali Inspectors were unnecessarily severe and stringent in the low figures and high efficiency of condensation they insist upon. Lehmann finds the effect upon the lungs and respiratory apparatus in the case of hydrochloric acid gas, and of ammonia so similar, that he considers them together. So thoroughly has he made his experiments, that not content with torturing to death a number of cats and guinea-pigs, that he might *post mortem* examine their lungs, &c., he subsequently operated upon himself and a friend. Of course he and his friend spared their own lives!

As Lehmann was unwell, the experiments on himself were scarcely useful, but those with the friend, a strong man of thirty years of age, are valuable. With air, in a close chamber, containing 0·05 per 1000 of hydrochloric acid gas, symptoms of irritation to the larynx and nostrils were experienced, causing continual sneezing; instinctively breathing was effected through the nostrils alone, and by means of small and superficial draughts of the acidified air. Gradually, a certain degree of smarting at the chest was felt, and some hoarseness; also there arose a certain choking sensation in the throat. No acid taste could be perceived, and no smarting of the eyes. The man, a stranger to such fumes, declared that to work in such an air-space would be intolerable, and begged, after twelve minutes, to be let out.

After more experiments on himself and others, Dr. Lehmann states that he thoroughly believes that people of sound lungs, after a certain degree of practice, may become accustomed to breathing small quantities of hydrochloric acid, even stronger doses than that mentioned above, without any too great difficulty or danger; but that the limits for any considerable stay in such atmospheres ought to be drawn at 0·1 as minimum or

0·2 °/₀₀ at the very outside as a maximum. Hirt specifies 5 to 10 °/₀₀, *i.e.*, 50 times as much as for a small dose, which, I confess, I should like to see him try for five minutes!

The appearance of the lungs of the animals experimented on, that had inhaled considerable quantities of ammonia and hydrochloric acid gas, Lehmann describes as almost exactly resembling those of such animals as horses and dogs that have been found in stables which have taken fire accidently, the animals having been choked to death with smoke and empyreumatic vapours.

Chlorine Gas.

This gas is prepared for the manufacture of bleaching powder (chloride of lime) or for the manufacture of bleaching liquor, which might be termed bleaching powder solution, by subjecting hydrochloric acid to the action of such an oxidising agent as manganese peroxide, or as in the Deacon process to the action of the oxygen of the air under special conditions. The hydrogen of the hydrochloric acid is thus separated to form water whilst chlorine remains as a greenish yellow heavy gas of peculiar odour which is greedily absorbed by slaked lime, milk of lime, or alkaline solutions. On the large scale, hydrochloric acid is run into stills made of flag-stone containing manganese peroxide, or if manganese mud be employed as recovered by the Weldon process, this is run gradually into hydrochloric acid contained in these stills, which are suitably heated with steam. The chlorine gas generated, passes through short removable arms of stoneware or lead to a gas-main which conveys the gas to leaden chambers resembling small vitriol chambers, sometimes set on the ground, sometimes mounted on pillars. In the latter case the finished bleaching powder can be more safely, quickly and comfortably shovelled through suitable openings in the floor into the powder casks placed below the chambers. These chambers are supplied with windows, one on each side, and by looking through from one to the other, little more than traces of chlorine can be distinguished by the colour communicated to such a thickness of air. Chlorine is an irritant noxious gas, and its odour is very characteristic. It is more choking than hydrochloric acid gas, and more difficult to get rid of from the respiratory apparatus when inhaled, for it is not so soluble in aqueous liquids, and hence, in the salivatic and mucous discharges the flow of which it excites. Nevertheless it is a gas to some extent soluble in water, and the solution in contact with air and light, rapidly becomes changed into one of hydrochloric acid. So great is the affinity of chlorine gas for fresh slaked lime, arranged as it is in ridges resembling a ploughed field, so

Chlorine gas.

as to give increased surface, that advantage is taken of this fact, to clear a finished chamber of residual gas, by simply connecting it by a light leaden movable pipe with a neighbouring chamber containing fresh lime, and leaving an air-hole or opening in the finished chamber. The attraction for the chlorine by the fresh lime soon sets up a draught, and fresh air is drawn in at the openings of the finished chamber and thus it becomes ventilated.

Bleaching powder.

Before 1886 a bleaching-powder man going to a chamber, and judging as to the complete absorption of the chlorine gas by a mere rule-of-thumb process, would proceed to open it, not unfrequently to find the gas only partially absorbed, sometimes still with a content of 100 grains of chlorine per cub. ft.; often with 15 or 18 grains of chlorine. The result of finding such a choking atmosphere was a rapid retreat for fresh air. Such rule-of-thumb or guess-work process was often due to negligence in keeping the glass windows or "sights" clean. Now, *i.e.* since 1886, these errors are prevented (except of course in cases of sheer wilfulness) by a rule made obligatory by the General Inspector in 1886–87, viz., that no doors shall be opened until, by a suitable test, the internal atmosphere is found to contain something below 5 *grains of chlorine per cub. ft.* The amount I understand that is usually kept to is 1 grain per cubic foot. A simple automatic test is provided for this purpose. To show how willing the alkali manufacturers are to meet the Inspector in any devices for the sake of the health and comfort of the workers, let me mention that Mr. Brock *(the Chairman of the Alkali Union)* himself introduced an additional rule and a process for more quickly removing the chlorine, viz., by a final diffusion of lime-dust through the chamber space. As it settles, this dust absorbs the residual chlorine gas, and a harmless atmosphere remains, which the packer can enter with safety and comfort.

Advances in sanitation of the bleaching powder industry.

Alcoholism, an obstacle to improved sanitation.

It is a singular thing that the profession of bleaching-powder packing and chlorine-still working, seems to be almost entirely in the hands of Irish workmen, and this perhaps accounts for the further suggestive fact, that the one desire of these men, with but few exceptions, is to find any excuse for claiming monetary assistance for the libations, "*the dhrop of Irish whuskey*," which form their invariable specific for all "gassing" ailments. No helmets, waterproof clothing, or respirators would last a week, if worn at all, in the majority of cases, if it were known that the whiskey money must be stopped. Bright exceptions to this general rule are to be found, but they are comparatively scarce. The packers prefer to bandage their legs well with folds of cheap cotton and brown paper, and also their necks, mouths, and nostrils with cotton folds, before enter-

ing the chambers. This it is quite as necessary to do on account of the dust of the powder as on account of chlorine gas. Of course the eyes are protected with large goggles, the lime-dust, nevertheless, sets up conjunctivitis from time to time. The preparation and sieving, as well as spreading of the lime in the chambers, is a trying piece of work; but the painfulness of it might be much reduced if the men would only accept the helps and defences that are offered to them, and especially abstain from whiskey drinking. The skin is generally greased by the men who enter the chambers. Vaseline ought to be used here again. I would also recommend the use of mouth sponges covering both mouth and nostrils under a less heavy cotton bandaging. The sponges are readily removed, and easily washed and wrung out from time to time. The bandages are often worn until both dirty and very acid, and when pressed against the teeth are likely to set up corrosion of them.

Dr. Lehmann On acquired hardening against chlorine.

Lehmann says that there is not the least doubt that gradually certain individuals amongst the workmen can get accustomed to inhalation of moderate quantities of dilute chlorine gas, but there are some individuals too who cannot acquire this habitude. The work's proprietor himself through repeated visits into the factory acquires some of this faculty. One manufacturer of bleaching powder told Lehmann that some workmen will occupy spaces for a day together which he himself would have to quit after only ten minutes duration. Christison, speaking of bleach works, states that the chief result of habitual exposure in the chlorinated atmosphere, is that the men get acid in the stomach and other stomach disorders, which they try to remove by taking chalk. These men never become stout, and if stout at first as other men are soon reduced to leanness, Christison finds that many of these men grow old, and he sees no reason for considering the work unhealthy.

Dr. Frank opposed to whiskey and spirits.

Dr. Frank has also noticed the tendency to leanness in workmen exposed to bromine vapours, which are more trying than chlorine. He recommends plenty of fat food, and the utmost abstinence from spirits.

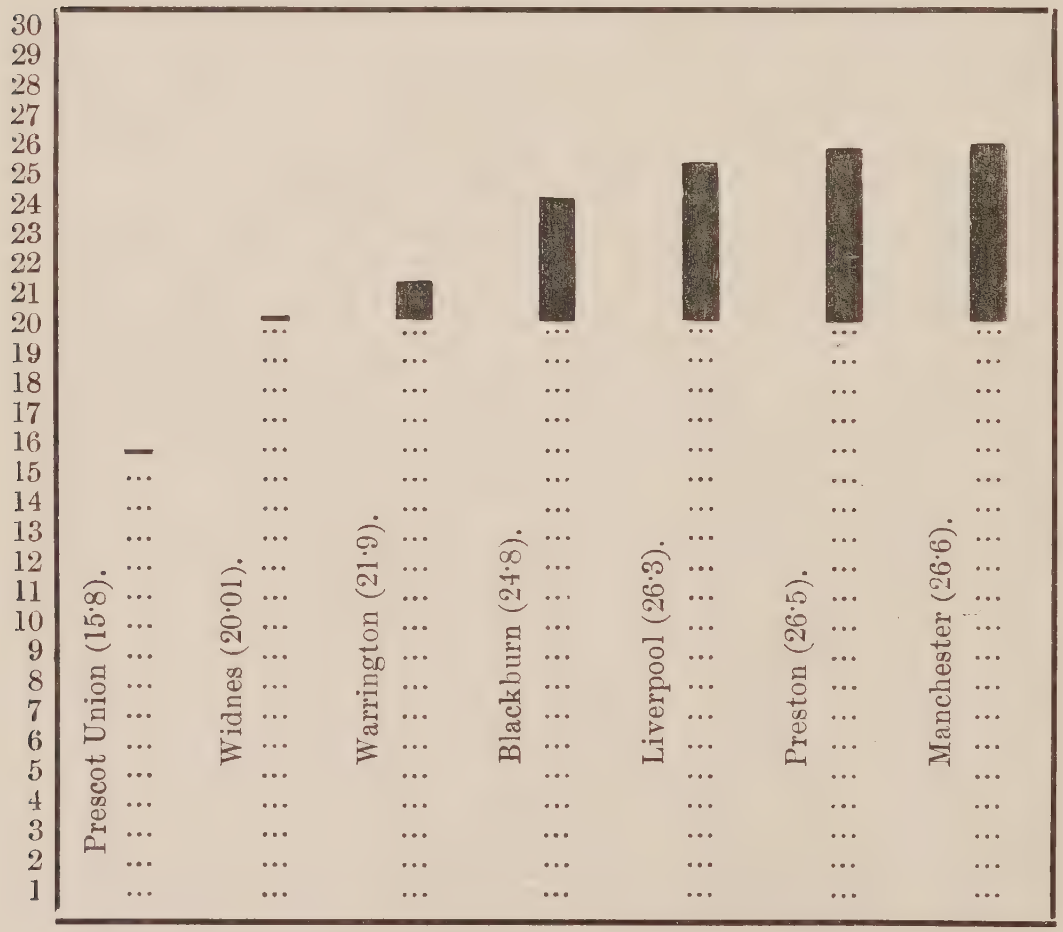
Incompatibility of chlorine and whiskey toddy.

This abstinence from spirits of course applies similarly in the case of chlorine, and yet we find the workmen insist upon drinking it as a remedy! I have known a man "gassed" with chlorine to take hot whiskey and water, and subsequently to become for the time stark mad, six or seven men being required to hold him. The statement that workmen exposed to chlorine atmospheres are predisposed to phthisis thereby, is contradicted by recent authorities. I myself have drunk small quantities of weak sulphuretted hydrogen water when gassed with chlorine, and with immediate relief. Renk, who studied the condition of

Weak sulphuretted hydrogen water an antidote.

the workmen in paper mills, where rag bleaching with chlorine takes place, could trace no injurious action of the chlorine at all. In the Bleachworks of Freiburg in Silesia, Hirt noticed the low rate of mortality of 1·25 per cent., and the high average longevity of from 56 to 58 years. Statements have been made as to the terribly unhealthy condition of Widnes, the great Lancashire alkali centre; my experience was dead against that, and I have here the death-rate of this town compared with those of larger towns, such as Warrington, Blackburn, Liverpool, Preston, and Manchester, showing that it is considerably below all these; indeed, the statistics I have here are those specially prepared for the Labour Commission, and they contain some very remarkable testimonies of workmen who have grown old in the alkali manufacture, and have also grown hale and hearty, because moral, steady, and temperate.

Diagram showing average death-rate of Widnes compared with other large towns, for the ten years, 1881–1890.



I now append the testimonies of several bleach packers and a "burner" man, employed by the Alkali Union, which speak for themselves.

Testimonies of workmen.

John Darlington was prepared to declare that :—He is a saltcake man at the Weston Alkali works. His age is 45 years. He has been employed at this work for 26 years. His general state of health is good. He has never known any men suffer in health in consequence of "gas." His hours of labour are 50 hours one week and 84 hours the other. The men, as a rule, are temperate. He, himself, was teetotal for five years, and now only takes liquor occasionally. The men, on the whole, are not improvident. He does not believe that the teeth of the men in the saltcake department are affected by the "gas," but that in cases where men suffer in this respect, it is a result of using dirty cloths in their mouths. The men have ample time for meals, and have half an hour to rest every two hours.

Thomas Percival was prepared to declare that :— He is a burner man at Messrs. Wigg Bros.' Works, Runcorn. His age is 58 years. He has worked (pyrites) burners for 17 years, and has been employed in a chemical works 44 years. He has enjoyed general good health. He does not consider that burner men suffer in health as a consequence of the conditions of labour. Although the hours on duty are long, the work is light, and only occupies about half the time. He has never seen any workman rendered insensible from the effects of gas.

Thomas Barnes was prepared to declare that :—He is a bleaching-powder packer at the Weston Alkali Works. His age is 53 years. He has been employed in packing "bleach" for 34 years. His general state of health is good, and he has only lost one day's work during the past 18 years through illness, which was in no way connected with the nature of his employment. He has never seen anyone insensible from the effects of chlorine gas. He does not believe that the work affects his health, but considers it a healthy employment. He does not consider it necessary to drink rum to enable him to perform his duties, but believes that he can work much better without intoxicants of any kind, which he thinks are injurious. He works from five to six hours per day.

John McLeod is prepared to declare that :—He is a "bleach" packer at Messrs. N. Mathieson & Co.'s Works, Widnes. He is 49 years old. He has been a bleach packer for 30 years, and has been employed in chemical works altogether about 33 years. He has never lost any time through illness in connection with his work, and has had very good health. He has never been rendered insensible from the effects of chlorine gas, nor has he ever seen anyone else insensible from

this cause. He has been practically teetotal for the last 13 years, and does not consider it at all necessary to take intoxicants to enable him to perform his work. He thinks the ordinary flannel muzzle the best means to adopt in packing a chamber. He has never found it necessary to complain of any of the conditions under which he is obliged to work. He works about 36 hours per week.

JAMES CAMPBELL is prepared to declare that:—He is a bleaching-powder packer at the Widnes Alkali Co.'s Works. He is 36 years old. He has been packing 16 years, and has been employed in chemical work about 20 years. His health has been on the whole very good. Has never seen or known any man to be rendered insensible from the effects of chlorine gas. Does not consider it necessary to take stimulants to carry on his work. Does not consider men employed in chemical works exceptionally intemperate. He does not consider the "Denayrouse" apparatus suitable for bleach packing. He has heard of it being used by a man at Muspratt's Works, but it was found to be impracticable. He would not be disposed to use it for this work himself, preferring to use the ordinary flannel muzzle. Has no complaints whatever to make regarding the conditions of his work.

The great bane of the alkali and bleaching powder worker is his usual partiality for spirits as a beverage. I have observed, and believe it to be generally true, that when syphilitic or scrofulous taint exists, the drinking of spirits brings such taint to the surface, and then very slight external influences suffice to bring forth eruptive diseases.

Strong cerebral action of Cl. and Br.

It may be well to remember that both with strong chlorine and bromine, a sudden exposure may result in a sudden lapse into unconsciousness with falling to the ground.

Pathologic action of Halogens, a periodic function.

Chlorine does not attack the cornea and eyes, nearly so quickly or painfully as bromine does. With the latter vapours, spasms of the eyelids of a very painful kind soon set in, the lids becoming tightly and spasmodically closed. The attack on the skin and mucous membrane, as Lehmann shows, is rapid with bromine but scarcely noticeable with chlorine, and of course it is still more rapid with iodine, and here we observe as in many of the other properties of the three halogens, this curious increase or diminution of affinity as the atomic weights rise or fall. Bromine acts with special vigour on the hair or fur of animals. Lehmann determined as nearly as possible the amounts of chlorine and bromine respectively, necessary to kill a small animal like a guinea pig. On calculating out the results, I find that the

average numbers representing the respective weights of chlorine and bromine, are as nearly as possible those bearing a ratio to each other of 80 : 35·5, *i.e.*, inversely as the atomic weights of these halogens. Hence the power destructive of life in these two substances, is in the direct ratio of the atomic weights. Probably iodine may be safely included in this law.

Lehmann considers that an atmosphere containing 1 to 2 millionths (0·001—0·002 °/₀₀) of chlorine or bromine is quite uninjurious and very little troublesome, whilst 0·003—0·004 °/₀₀, 3 to 4 millionths, are very irritating and cannot long be endured advisably. 0·005 °/₀₀ should be perhaps regarded as the maximum amount that can be safely tolerated for a brief period. Larger proportions than the above, for periods of a few hours, can only be inhaled with danger of injury.

In his experiments on small animals Lehmann could detect no action on the heart that could be taken into account, also the action on the eyes, mouth and mucous membrane of the nostrils was comparatively insignificant, but bromine distinguishes itself greatly over chlorine in its action on the hair and epithelium of the stomach, whilst the kidneys, liver and other abdominal organs were not much affected in the case of either gas. The curious distinction between the action of the halogens in vapourform and that of their hydrogen compounds, hydrochloric and hydrobromic acids, was observed to be, that the halogens exhibit a much stronger cerebral action, if indeed any cerebral action at all in the case of the hydrogen acids can be spoken of. It is interesting to note that Lehmann after his experiments in a closed chamber, went to a German paper works and examined the bleaching departments and its conditions. He found that the average amount of chlorine in the vicinity of the souring vats during the process varied between 0·001—0·004 °/₀₀ of chlorine, *i.e.*, 1 to 4 millionths. He observed that the workman at the period of strongest gas stood in the doorway to get as much fresh air as possible. This individual told Lehmann that at first the gas gave him a severe catarrh with expectoration of much mucous, &c., but that gradually he had grown accustomed to the gas, and ceased to become affected. He seemed to be a thoroughly healthy man.

Noteworthy distinction between actions of halogens and their hydrogen acids.

I quite agree with Lehmann as to the possibility of becoming hardened to the action of small quantities of the pungent gases mentioned, which are not what I have described as *insidious*, but I would ascribe a great deal of this so-called "hardening" to a kind of acquired skill gradually taught by instinct, and which cannot be adequately described. Nevertheless, I believe it can only be acquired by persons with sound lungs. I myself have often breathed with a fair degree of comfort in atmospheres

Acquired skill in breathing in chlorinated atmospheres.

containing hydrochloric acid or chlorine, in which I have observed a novice almost choking. The kind of acquired respiration necessary, I can only describe as one in which a larger number than usual of cautious but superficial (*i.e.*, not deep) inhalations are taken, not through the mouth, but through the nostrils. With one or two deep breaths through the mouth the novice is placed "*hors de combat!*"

Injuries caused by contact with Gases and Liquids—Prevention and Treatment, &c.

I notice in my reading of the great German organ of the Chemical Industries, "*Die Chemische Industrie*," that the large number of accidents which occur to workmen appear to arise through various intricacies of the apparatus in German factories, and through what seems to me as I read, the nervous desire to show an over-hasty obedience, combined with a lack of personal observation and independent judgment and self-reliance. I put a great deal of this down to the effect of hard military discipline, and say without hesitation that a good sturdy Irishman would know how to protect himself a great deal better, and yet do his work. If we add to the disability named, the greater complexity of German apparatus, already mentioned, and the increased minutiæ, I do not wonder at the records of so many injuries caused by men falling down ladders here with jugs of vitriol in their hands, and turning wrong taps on there, and in violent haste to set things right, getting hold of other wrong taps, and injuring the face and eyes with something yet more noxious. I trace these accidents in great measure directly to stringent militaryism, which has converted men into so much unself-reliant machinery, and I say, let not readers of the journal quoted think that British workmen thus suffer, because I can assure you it is not the case, nor do the manufacturers here need such an excess of bye-laws, restrictions, and precautions. We have our own peculiar faults, but we are not over-drilled!

However, we shall do well to hear of the means of preventing injury, remedies, etc., compiled by the German firm, K. Oehler & Co., Offenbach-a-M., on "*Corrosion and Burning with Inorganic Acids and their Treatment.*"

I should like, on perhaps another occasion, to give the text of this interesting and valuable pamphlet, but will now content myself with a summary.

1. In the case of any burn with strong acids, the chief measure of importance is as quickly as possible to dilute and

remove the acid from the part affected by copious affusions of water.

2. The neutralisation of any remaining acid by means of weak solutions of alkaline carbonates, is desirable.

3. A corrosion is simply a burn, and must be treated as a burn: air-tight bandage, with goulard water compression.

4. With extensive burns, it is highly desirable to avoid, in every possible way, a loss of heat or chill in the subject under treatment, by administration of a warm bath; warm lead-water compressions, &c. Nevertheless, it is perfectly evident that the quickest possible dilution, and washing away of all acid, must be regarded as the first duty to the man.

In the case of burns and scalds, we in England are almost invariably supplied with a stock of the good old linseed oil and lime water, and this is highly spoken of too in Germany as a safe palliative in unprofessional hands. But a better remedy still is one devised by the large German firm, Bayer & Co., of Elberfield, for use for their workpeople in case of burns and scalds. This consists of an organic preparation called "*Aristol*," an Iodo-thymol compound, which is used in the form of a 10 per cent. lanoline or vaseline salve, or even in the form of powder, to be laid upon the wound. A subnitrate of bismuth, as prepared by a South German firm, is also very warmly recommended for burns. Either of these preparations much diminishes the pain of the wounds.

In all places where dangerous work is carried on likely to bring about burns or scalds should accidents occur, it is recommended that plentiful supplies of water should be close at hand.

Use of spectacles.

The use of suitable spectacles is strongly recommended by Lehmann and by the various authorities, and great fault is found with some spectacles that are already in use. It also appears, that like their English brothers, many of the German workmen will not wear these spectacles if they can help it, or even respirators. The kind of spectacles most recommended are those devised by Stroof, and patented by him. These have means for the circulation of air through them, and thus the eyes are kept cool.

Another kind of spectacles obtained the first prize recently from the *Association des industriels de France contre les Accidents du Travail.* This prize was won by Simmelbander, of Montigny, near Metz. It is made with trapezoidal glasses (J. Soc. Arts, Aug., 1893, 876), surrounded by wire gauze; does not heat the eyes, and is specially useful in cases where corrosive liquids may be thrown about in spray as the result of accident or otherwise.

Protective mask.

Dr. Lehmann most strongly recommended the use by workmen and others of a protective mask, invented by Herr Pitzner, Engineer in Chief of the Seydelmayer Brewery in Munich. Lehmann has worn this mask himself in all kinds of noxious atmospheres and thoroughly experimented upon it. It appears actually to be a kind of light helmet made of soft indiarubber, which loosely encloses both head and neck, whilst the eyes are protected by two large circular glasses. In the neighbourhood of the mouth is a strong indiarubber tube passing out into the fresh air and connected with a powerful bellows. Whilst the workman operates in the noxious atmosphere, a strong stream of fresh air is blown to his mouth, the loose soft rubber around the head and neck expanding or contracting as the excess of air increases or diminishes. Also any openings through the loose fastening of the helmet are of no detriment, the escaping air preventing return of obnoxious gas. Lehmann's exhaustive experiments with the mask show how effective it is, at all events, for a man not attempting any hard work in it.

Formerly used noxious respirators in Germany

It appears from Lehmann that, at one time in Germany, sponges moistened with aniline were recommended as respirators for men working in atmospheres containing chlorine, and these he properly condemns, since aniline vapours are more noxious than chlorine itself! It may be interesting to refer to a paragraph written by Lehmann on the attempts that have been made to disinfect human beings in cases of serious epidemics, with chlorine and bromine vapours. He points out that the experiments of Fischer, Proskauer, and others, demonstrate the futility of any such method of disinfection, since it was found that for the destruction of the organisms it was necessary that the moist atmosphere of the sterilizing chamber should contain 3 per 1000 of chlorine, or 2·1 per 1000 of bromine, and the exposure should continue for three hours, or there might be used an atmosphere containing 0·4 per 1000 chlorine or 0·3 per 1000 bromine, with a twenty-four hours' exposure. Lehmann very pertinently, and somewhat humorously, says: "The micro-organisms would, under the above conditions, be very effectively slain, but so also would the patients!" Besides many pathogenic bacteria can easily withstand the action of an atmosphere containing as much as *4 per cent.* of chlorine for an hour together.

Disinfecting human beings with chlorine and bromine.

Before concluding, I should like to refer to one or two facts of great interest:—

Chemical workmen with scrofulous taint.

The first is the predisposition, as already mentioned, to eruptive complaints shown by a certain class of workpeople of scrofulous or syphilitic taint. Dr. Arlidge in his work mentions the occurrence of skin eruptions in the case of bleaching

powder workers, through the action of the chlorine. Such eruptions I have never observed, but I can say this, that men who inherit scrofulous taint, are quite liable to such eruptions in chemical works at the slightest provocation. Such persons, as well as those with lung diseases, or even with heart disease, should, if possible, choose other work to do.

The second is the curious fact that in some chemical works in which a variety of products is manufactured, it is found that the influence of the conditions of one department acts as an antidote to those of another in which some injury is contracted, and accordingly the men are changed about from one place to another.

Are our alkali and acid manufacturers humane masters and employers?

In conclusion, and in view of some hard things that have been said of the chemical manufacturers in their relations to their workmen, I should like to mention two facts which have recently come to my notice, and after mentioning them I am content to leave it to the public verdict, whether the chemical manufacturer, and more especially in this connection, the alkali maker, does not possess his share of humanity.

The first fact is that at a recent meeting of the Liverpool Section of the Society of Chemical Industry, two of the chief magnates of the Alkali Union set forth the advantages and spoke entirely in favour of, an eight hours day for the alkali men. The second is what I call a beautiful testimony to the same good feeling. During the late coal famine, when many of the Alkali works were brought to a standstill, especially in and around St. Helens, the principal officials of the United Alkali Co. started a relief fund for their out-of-work hands.

A strong committee was formed, with a secretary and treasurer, and this committee had received promises of weekly contributions amounting to £150. It was estimated that these sums would provide 2s. 6d. per week for each single man, and 5s. for each of the married men, thrown out of work through the scarcity of fuel. The first distribution of relief was made on Nov. 20th, when 742 workmen, representing 2,500 souls, participated. But numerous outside applicants for relief presented themselves, and an appeal was made for public support.

Hence, the hearts of this Alkali Union Committee were good for their own men, and large enough to take in the woes and distress of a famine stricken population outside them.

LECTURES TO SANITARY OFFICERS.

WATER SUPPLY FOR DOMESTIC USE.

By J. WALLACE PEGGS, Assoc.M.Inst.C.E.

Delivered 10*th October*, 1893.

The plentiful supply of water for domestic purposes of good quality is of paramount importance, as we now know that many diseases, cholera and typhoid fever especially, may be spread by drinking foul water.

Sources of Water.

As all sources of water supply are derived from rainfall, a short consideration of this interesting subject will be necessary before proceeding to the various sources of supply themselves.

Rainfall Evaporation and Percolation.

The amount of rainfall varies in different parts of the world, and even in different parts of England. The average rainfall over England may be taken at 30 inches per annum, equivalent to 3,000 tons per acre. In parts of India, however, more than this amount has fallen in one day.

It will be useful and instructive to explain here how rainfall is measured. The apparatus for measuring rainfall is called a rain-gauge, and the size usually adopted is 8 inches in diameter. The most generally useful pattern is made of copper, in two parts, and consists of a lower cylindrical part and an upper deep funnel part, with a strong truly-turned rim of brass, leading by a small pipe into a bottle within the copper cylinder, so placed as to be protected from breakage by frost and from evaporation. A small graduated glass of an area one-tenth of the mouth of the funnel is used to read off the amount of rainfall direct in inches and decimals of an inch.

The rainfall over the British Isles varies considerably, and the best way of studying its distribution is from the map prepared by Mr. J. G. Symons, F.R.S., for the Sixth Report of the Rivers Pollution Commission.

Upon this map rainfall contours or lines of equal rainfall are shown, and the spaces between or areas of equal rainfall are

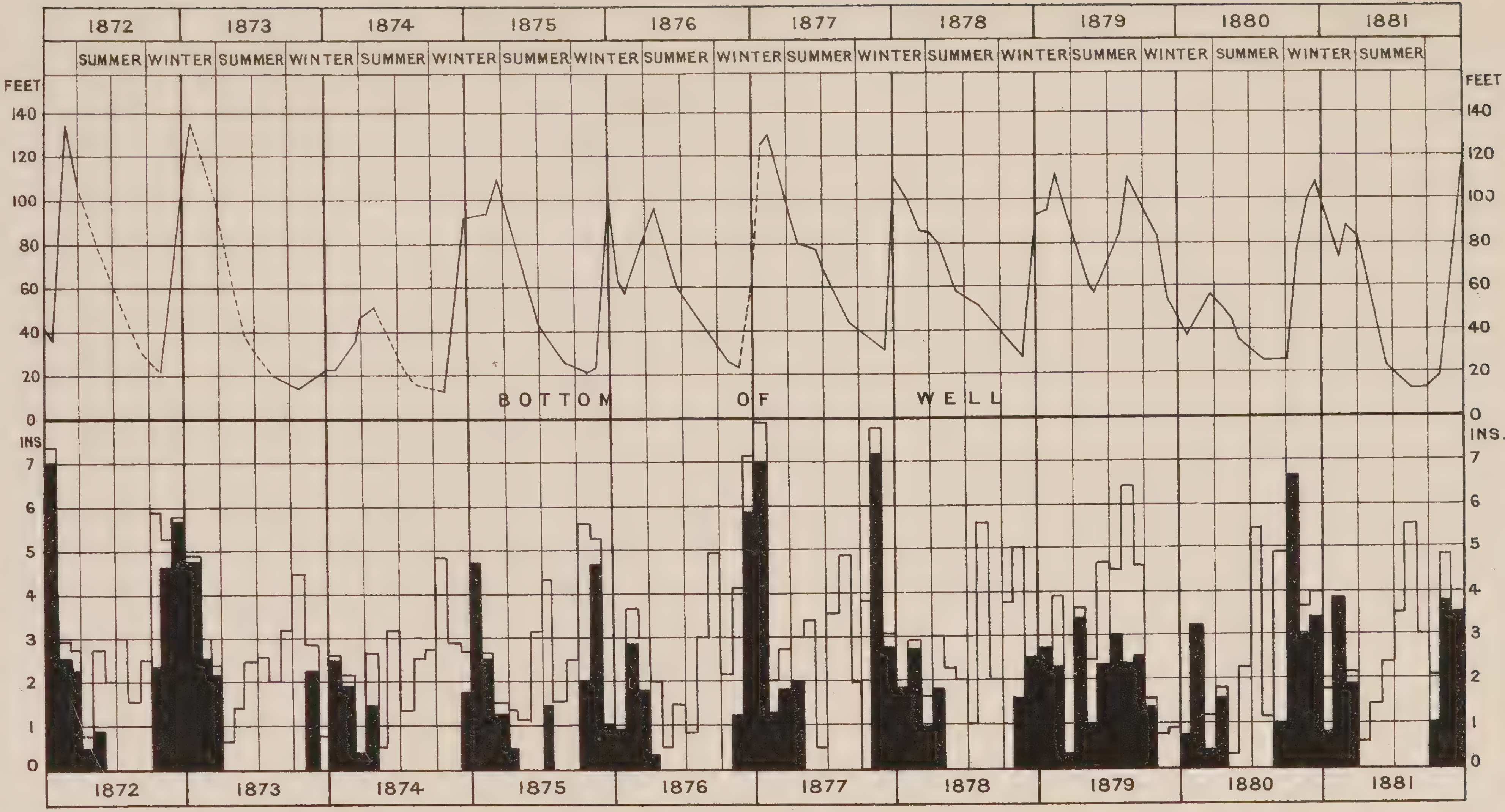

1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
SUMMER
WINTER
FEET
140
120
100
80
60
40
20
0
BOTTOM OF WELL
INS.
7
6
5
4
3
2
1
0

Fig.1.

SEASONAL VARIATION
OF
FLOW OF UNDERGROUND WATER.

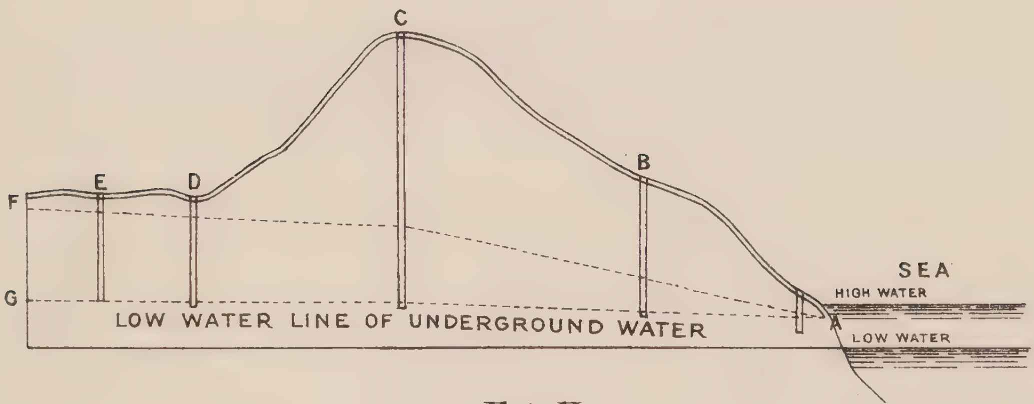


Fig. II.

Fig. III.

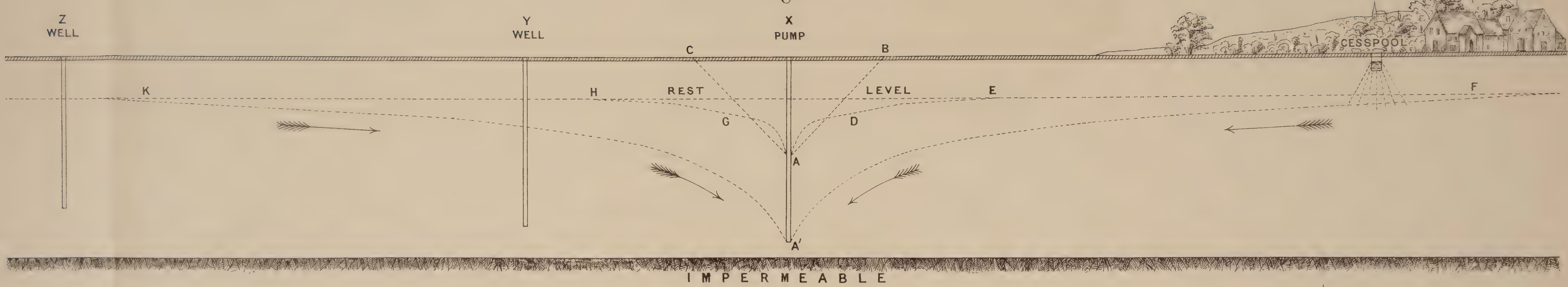
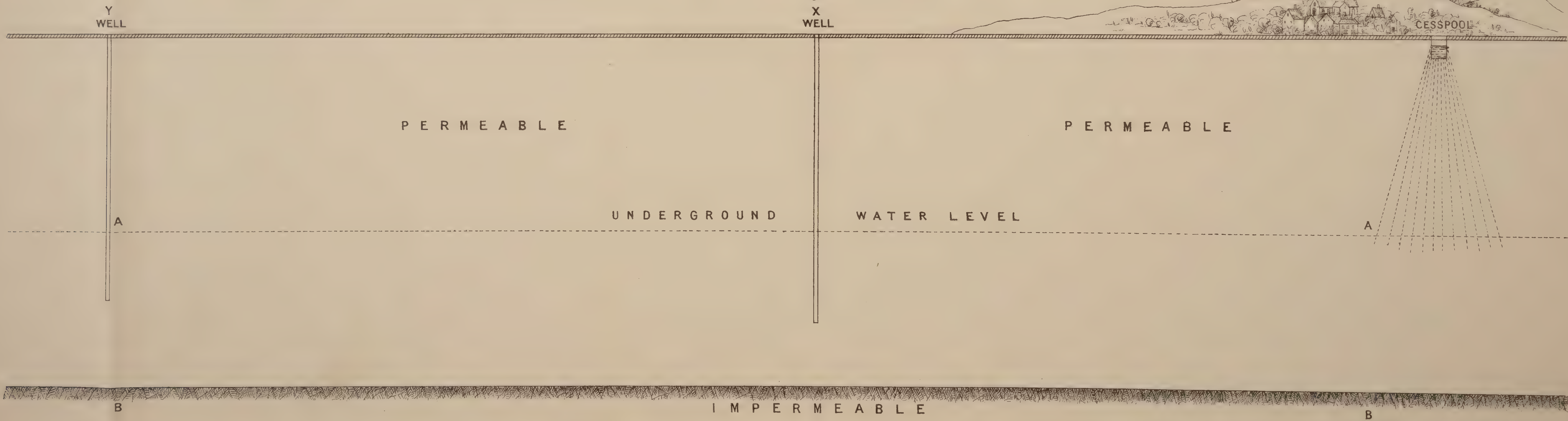


Fig. IV.



J Wallace Peggs, del[t]

and the water supplies of some of our large manufacturing towns in Yorkshire and Lancashire form notable examples of such works. For example, the water supplies of Liverpool, Bradford, and Bolton. The city of Dublin is also supplied with water from the Wicklow Mountains, 26 miles distant.

These impounding reservoirs or lakes are formed by building a dam across the neck of a valley suitable to contain a supply of some months even in the driest year.

Peaty matters are frequently present in upland surface water, giving it a decided colour. Filtration through beds of sand is sometimes made use of to remove peaty matters and discolouration.

Waters supplied from natural lakes, such as Glasgow from Loch Katrine 34 miles distant north of the city, may also be considered as upland surface water. This Loch Katrine supply took the place of the much-polluted Clyde water, and the construction of the works was due to the genius of the late J. Frederick Bateman, F.R.S., Civil Engineer.

For engineering purposes in estimating the water supply from a catchment area the least rainfall has to be considered, as this is the crux of the question.

The rainfall which flows directly off the surface forms rivulets, which join to form the streams, which again flow to the river systems.

Streams and Rivers.

The rivers and streams were formerly the usual source of water supply, and London is the most notable example of a city supplied by river water. The city and county of London is supplied by eight water companies, five of which draw their entire supply from the River Thames above Teddington. It has been stated in evidence that during the summer of 1887 more than one-third of the entire flow of the river was taken for the water supply of London.

The water supply from rivers has been abandoned to a great extent, on account of the pollution of rivers by raw sewage, and this brings me to say a few words about the deplorable pollution of many of our beautiful rivers.

Unfortunately, the Public Health Act of 1848 encouraged the emptying of raw sewage into rivers. It is certain that, unless a more workable Act can be obtained, most of our rivers will become not only polluted but will be in many instances a danger to health.

The existing Rivers' Pollution Prevention Act has been adverted to in the late Royal Commission on London Water Supply by Dr. Ashby, Medical Officer of Health for Reading, as "more or less a dead letter."

We have seen already that the source of all water supply is from rainfall. Of the rain descending upon the ground, part percolates into the soil and descends through it to a level where it is held up by an impervious stratum, such as many of the clay beds. The amount of percolation has been measured by what are called percolation gauges, the earliest form being that of Dr. Dalton, of Manchester. Springs and the flow of underground water.

Extensive experiments have also been made by Sir John Lawes and Sir H. Gilbert upon percolation gauges of an area of $\frac{1}{1000}$ of an acre.

In order to bring before you in a graphic manner the relation between the rainfall and the rise and fall of the underground water, a diagram has been made which is from the one prepared by Mr. Rogers Field and the author for the article on "Water" in "Our Homes,"* and is, as far as the author is aware, the only attempt to show graphically the connection between rainfall percolation and the rise and fall of the underground water.

It is commonly known to those who have to draw water from deep wells by means of a bucket and rope, that they have to wind up more rope in autumn than in winter; or to express this more carefully would be to state that the level of the water in the well is at its lowest in October and November, and then rises rapidly until February and March, when it is as a rule at its highest level, and then it gradually sinks through the summer to the autumn low level.

Referring now to the diagram, Fig. I., which is drawn out for ten years, it will be noticed that lines divide each year into four parts, and the divisions of winter and summer are also marked. The upper part of the diagram shows the heights of the underground water in the chalk, as measured at Chilgrove, Sussex, by Mr. Woods, and are plotted in feet above the bottom of the well, which is taken as the datum. The lower part of the diagram shows the rainfall aud percolation in inches, the percolation amounts being the black portion. The rainfall is from the record kept at Chilgrove, and the percolation in the chalk is from the records kept at Nash Mills, Hemel Hempstead.

Now the first thing which will be noticed on examining the diagram is that the bulk of the percolation is in the winter (except in the year 1879), when the ground is already saturated, and that there is none in the summer, because of the evaporation and absorption by vegetation. The next noticeable feature is that the underground water is highest in the early part of the

* "Our Homes and how to make them healthy." Cassell & Company.

year, January and February, and lowest in October and November, and that it follows the amounts of percolation.

Not only is the level of the underground water rising and falling as we have seen, but it is always moving slowly through the strata containing it with a definite gradient towards certain outlets, sometimes to a river, sometimes to the sea level, the latter case is well shown by the Brighton section, see Fig. II. The general notion prevails that a well has only to be sunk at some desirable spot, and if you are fortunate you find water in some such way as you might find a nugget of precious metal, but a moment's consideration will show that this is not the case. Where water is found by sinking a well you are drawing from the general underground water. This is a very important point, as we shall see further on. The upper and lower dotted lines in the diagram, Fig. II., show the high water and low water levels, from which it will be seen that great seasonal variations exist, the water in the wells B, C, D, E, rising and falling considerably. In the autumn months the underground water level would be along the dotted line on the diagram A, G, but in the winter it would have risen along the line A, D, E, F, the water standing in the wells at a higher level, and the gradient being much steeper towards the outlet A. In chalk districts the seasonal variations are from 50 to 100 feet.

Wells—Shallow wells, Deep wells, Artesian wells, Tube wells.

In districts where an impermeable stratum underlies permeable or porous strata, such as the gravel "outliers," upon the clay around London, wells sunk into the porous strata will yield water at depths varying considerably according to circumstances. The distinction between shallow wells and deep wells is not very clearly defined, but, speaking generally, wells sunk into superficial beds are called shallow wells, and wells sunk into geological formations and deep beds are called deep wells. Such, for example, as the deep wells in the New Red Sandstone at Liverpool, and the deep wells in the chalk around London.

In some cases, owing to the position of the water-bearing strata, the water rises to the surface, and in some instances considerably above the surface, as at the celebrated well at Grenelle, near Paris, and many in our own country. These wells, the water from which rises above the surface, are called Artesian wells, so named from the province of Artois, where they have been long in use.

Tube wells, or Abyssinian wells, form a simple means of reaching water-bearing strata at moderate depths, and have much to recommend them from a sanitary point of view. They have in many instances yielded good supplies on a small scale.

Rain-Water from Roofs.

Rain water collected from roofs in rural districts gives an excellent supply on account of its great softness. It is, how-

ever, quite insufficient under many circumstances, but where earth-closets are used it may sometimes be made sufficient. Great care should be taken to prevent leaves, soot, and refuse from entering the storage tank. The best way is to have a rough filter, constructed in two portions, one merely as a settling chamber, and the other a rough filter of small washed stones.

With reference to the quantity of water obtainable from roofs, this is entirely governed by the rainfall of the district in the driest year, and the area of the collecting roof. In the West of England the average rainfall may be assumed as 36 inches, and the fall in the driest year as 24 inches. Taking the loss from evaporation and absorption at two inches, we have 22 inches of rain left as available. In the East of England the average rainfall would be 24 inches, and the minimum 16 inches, and taking a loss of two inches as before, we have 14 inches as the available rain in a dry season.

There is a very simple rule by which the available quantity of rain-water may be calculated approximately. It is as follows: Multiply the area covered by the roof in square feet by the average annual rainfall, also in feet, and divide the result by 100, will give the average supply in gallons per diem for a very dry year.

The next most important point with reference to rain-water collection is to have sufficient storage or a tank of sufficient capacity to tide over the longest droughts. The simplest way is to calculate the capacity of the tank from the roof area, and it has been found by practical experience that two gallons for every square foot of roof area must be allowed for in constructing the tank.

Much interesting and useful information on the collection of rain-water from roofs will be found in a pamphlet by Mr. Rogers Field, International Health Exhibition Handbook, 1884.

As rain-water has the quality of great softness care must be taken not to use any lead pipes or connections in pumps or fittings. Cases have been known of water pollution caused by a piece of lead pipe being used to join the iron suction pipe to the pump barrel, in fact, the ordinary piece of lead pipe supplied with hand pumps.

Depression of the Underground water caused by pumping.

When water is pumped from a well the effect is first of all to lower the surface of the water in the well, and afterwards to lower the underground water for a distance around the well, and if the stratum is fairly homogeneous this depression will be equal around the well, and will extend in a circle drawn with the well as a centre. In some cases, however, the figure would be more or less irregular and would not be a circle.

This depression has been likened to an inverted cone, as was

first pointed out by Robert Stephenson in his masterly report to the Liverpool Corporation in 1850. In the case of wells in the New Red Sandstone, which is fairly homogeneous, this coning would give a fairly correct idea. On referring to diagram No. III., the effect on the surrounding underground water of pumping a well to different levels is shewn by the curved lines. It is quite evident that the straight coned figure originally assumed was not correct.

Area affected and the influence of one well upon another.

It used to be assumed by writers on water supply that the depth of the well was the factor which regulated the area affected, but this is not so. What does affect it is the extent of pumping in lowering the underground water level. This is an important consideration, as the influence of a shallow well may extend much further than a deep well, if more water is pumped from the shallow well so as to lower the water level more. It will be seen, also, from the diagram No. III., that if the extent of the influence of pumping be represented approximately by a circle, the more the water is lowered the larger will the circle be. No general rule can be given as to the distance from the well to which the effect of the pumping extends, as it varies greatly according to the character of the strata and other circumstances. In order, however, to give an idea, it may be stated that investigations into various cases in which the distance has been ascertained, appear to shew that under ordinary circumstances it varies from 20 times to 100 times the depression or more, *i.e.*, if the water in the well is depressed five feet by pumping, the distance from the well to which the effect of this pumping extends may vary from 100 feet to 500 feet or more. If the depression is 10 feet the influence would extend nearly twice as far.

Leakage from Cesspools.

The great danger from a sanitary point of view as regards wells is that they may be polluted by sewage, leakage from drains or cesspools. This danger applies more to shallow wells than deep wells. At the same time deep wells are not safe from such pollutions, as shown by what took place at Liverpool in 1872. This is such a striking case that it will be interesting to give a few particulars. The deep well in question is the Dudlow Lane Well, belonging to the Liverpool Corporation, sunk into the New Red Sandstone formation, 443 feet deep, 247 feet being sunk as a well, and 196 feet being the depth of bore hole. The continuous pumping of this well dried all the wells belonging to the houses in the neighbourhood, and these dry wells were afterwards used as cesspools. The consequence was that the water in the deep well became polluted, and five years after the well had been constructed the pollution was so serious that the well had to be disused.

The Liverpool Corporation took measures to induce the Local Sanitary Authority to carry out a system of sewerage, and divert the drainage of the houses from the cesspools, and by these measures the quality of the water in the deep well was so improved that pumping was resumed, and the water from the deep well was again used for the supply of Liverpool.

The recent case at Worthing is another striking instance of the water in a deep well becoming polluted by sewage escaping from leaky sewers and drains.

In diagrams showing the pollution of water in wells by sewage, it is generally indicated by streams of sewage matter issuing from the sides of the well, indicating a direct passage of sewage from drains and cesspools into the well. Although as you are well aware this is sometimes the case, it is by no means the most usual mode of pollution.

The usual cases met with in practice are much less apparent, as the pollution is effected by the sewage passing into the underground water and not into the well direct.

The polluted underground water may reach the well in two ways. 1st—by the natural movement or flow of the underground water. 2nd—by the polluted water being drawn towards the well by the influence of pumping.

The diagram No. IV. has been prepared to show the first-mentioned case, where AA indicates the level of the underground water in permeable strata, BB being impermeable strata holding up the water. A porous cesspool at C is allowing sewage matter to percolate until it reaches the underground water. At X and Y are wells sunk into the underground water.

Now it has been previously explained that all underground water has a slow movement towards some outlet, and it therefore depends which way the underground water is supposed to be moving whether the wells are polluted or not. If the movement is from X to C no pollution takes place unless depression by pumping causes it. If on the other hand the movement is from C to X pollution must take place whether there is pumping or not.

Sending the sewage into a porous cesspool in permeable ground near a river will not prevent the river from being more or less polluted, inasmuch as the underground water will be polluted, and this will flow by its natural movement into the river.

The second case of polluted underground water reaching a well is shown by the diagram No. III. before referred to. If the well is pumped down to A it will not draw the water from beneath the cesspool, but if pumped down deeper to A^1 it will

influence the underground water to a greater distance, and pollution will be drawn into the well from the cesspool.

Another important consideration will be seen from the diagram, viz., that a well which gives good water when only slightly used may become seriously polluted if drawn upon largely so as to extend its sphere of influence to cesspools which were outside the sphere of influence when only slightly drawn upon; for instance, a well might give quite a good water for the supply of a house where a bucket or hand-pump is used, but if steam-pumping were resorted to for the supply of a village the water might become contaminated.

Composition of Water from various sources.

It is not proposed in treating of this part of our subject to go into the question of chemical analyses, but simply into the quality of water as affected by the gathering ground or the strata through which it passes. When rain has descended upon the earth it depends obviously upon the character of the gathering ground and the strata through which it passes for its hardness and impurities. The length of time also in which it is in contact with those surfaces, calcareous and magnesian soils or strata cause water passing over them to be hard.

The evils arising from the use of hard water are very apparent, not only in cooking and washing, but in hot-water apparatus for heating and hot-water supply, and also in steam boilers.

It has been calculated that a saving of £36,000 per annum in soap alone was effected in the city of Glasgow by the introduction of the soft water supply from Loch Katrine.

Water may be softened by distillation, by carbonate of soda, by boiling the water, and by the lime process of Dr. Clark. The first and second methods are effective but too expensive on a large scale. The third and fourth are efficient only with certain classes of water. The fourth, however, is cheap and applicable to large town supplies. Carbonates of lime or magnesia (temporary hardness) can be removed by Dr. Clark's process. The process known as the Porter-Clark process is largely used for softening water for manufacturing purposes, for ice making, and for use in locomotive engines on railways.

The quantity of water required for various purposes.

From a return made to Parliament in 1879 of the water supply of every urban sanitary district, the amount used was shewn to be from five gallons per head per diem to 50 gallons per head per diem.

The quantities of water supplied to various towns is as follows:—

London (average) 31·19 gallons, according to the recent Report of the Royal Commission on Metropolitan Water Supply.

Manchester 21·00, proposed to be 50 to 60 gallons when new works are finished.

Norwich 14·50.

Glasgow 50·00.

Ancient Rome is calculated to have been 300·00 gallons per head per diem.

A supply of from 20 to 25 gallons per head per diem is sufficient for ordinary houses with baths and water-closets, but for horses a separate allowance should be made. If water be required for watering a garden or for ornamental purposes it must be reckoned separately.

In country places if earth-closets are adopted less water would be required, 15 to 20 gallons per head per diem would be ample. In cottages with earth-closets still less supply would be required, and there 10 gallons a head per diem would suffice.

The allowance generally made for various purposes is as follows:—

Domestic	9	gallons.
Water-closets	5	,,
Baths	5	,,
Washing	3	,,
Waste	3	,,
Town Purposes	5	,,
Trades	5	,,
Total	35	,,

By the term constant supply is meant that water is continuously supplied to the house, *i.e.*, that the service pipes to the houses are always kept full under pressure so that water may be drawn by the taps at any time direct from the main. Constant and Intermittent supplies.

By intermittent supply is meant that water is only turned on to the house at stated intervals, necessitating the use of cisterns to store the water.

The chief advantage of the constant system is that the water can be drawn direct from the mains without storage in cisterns, so that the pollution which so often takes place in cisterns can be avoided. This pollution occurs in a number of ways well known to you, viz., the connection of the overflow pipe of the cistern direct with the sewer; by dirt collecting in cisterns; or by rats, mice, or birds. As an instance of the latter pollution, a friend tells me that a bird entered his cistern through the overflow pipe, and the bird died there as it was a covered cistern, and caused pollution to the water. The subsidiary

advantages of the constant supply is that water may be drawn fresh and cool direct from the main. The cost of storage cisterns is avoided, and only flushing cisterns are required for W.C.'s.

Also the water is constantly on all the branch mains in case of fire.

The advantage of the intermittent supply was supposed to be prevention of waste of water, but recent experience has shown that the constant supply is as economical as the intermittent.

The intermittent was formerly the usual method of supply, but the constant supply is now being adopted, and even in London, the most striking instance of intermittent supply, the constant system is being largely introduced.

Supply of water by meter.

Water meters are in England generally only used for trade and manufacturing supplies, the domestic supply being charged according to the rateable value of the house, with certain extras.

In Berlin and other places on the continent the whole supply is charged for by meter.

Contamination in reservoirs and water mains.

Where service reservoirs are in the neighbourhood of towns there is evidently always danger of the water in them being contaminated, and they should therefore always be of covered construction.

In the case of water mains it would at first sight appear that it is impossible for the water in them to become polluted, as if there were a bad joint or hole in the pipe, or even a broken pipe, water would escape under pressure and there would be no tendency for extraneous matter to enter the water main. This is not true even when the pipes are kept constantly full of water, as under certain conditions, which, however, do not often occur, the water rushing past a hole may create an insuction.

In practice, however, even with a constant supply, the pipes are not always kept full of water, as they have to be emptied for repairs and for making new branches, and when emptied an entirely new condition is introduced. A vacuum is often then created, so that there is a powerful insuction into the pipes through any opening there may be.

If the main therefore passes through polluted ground, which is generally the case in towns, polluted matter will be sucked in, and when the water is turned on again into the mains it will become distributed with the general supply.

Many outbreaks of fever have been traced to contamination of the water supply in this way.

Filters.

Waterworks filter beds generally consist essentially of a thick layer of sand over coarse gravel, in which porous pipes are laid to convey the filtered water to a storage reservoir. A film of

glutinous silt collects on the top of the sand, which gradually chokes the filter, and this has to be cleaned off at intervals.

Waterworks filters if properly managed are very efficient, but it is very different in the case of domestic filters. These require cleaning and renewal as much if not more than the waterworks filters, but as a matter of fact they do not receive the proper attention, in fact, they are frequently not attended to at all. Consequently, they often collect so much objectionable matter that they make the water passing through them worse instead of better.

This is especially the case when animal charcoal is used, as the pores become clogged with putrescible organic matter, which forms a breeding ground for living organisms.

OBJECTS AND METHODS OF INSPECTION.*

By JOHN F. J. SYKES, D.Sc., M.D., M.O.H. St. Pancras.

Delivered November 14th, 1893.

In the General Order of the Local Government Board, dated March, 1891, set out in detail and included in the Syllabus of Examination of The Sanitary Institute, will be found enumerated the duties of Inspectors of Nuisances, and the subjects to which they relate. It will not be necessary, therefore, to occupy your time by reciting a long list of subjects for inspection, the principal objects of which are:—

1. The discovery and abatement of nuisances and of sanitary defects for the protection of health.

2. The prevention of the spread of infectious diseases.

3. The supervision of the quality and wholesomeness of foods.

The Inspector is set in motion by—(1) Complaints received; (2) Infectious diseases notified; (3) Instructions to inspect specified streets, &c., from house to house, and (4) Instructions to periodically inspect specified premises.

Method in inspection is important. Always take notes in writing, and record exactly what you find. Avoid all prejudice and the personal equation as much as possible. Distinguish what you find from what is told you, and note by whom you are told. Be exact as to names, places, hours, and dates, and details generally. Cultivate the art of observation and enquiry. Know your subject that you may know what to observe and what to enquire into. I will endeavour to illustrate my meaning by instances of observation and enquiry generally, and then describe more especially the inspection of dwelling places and other premises.

Overcrowding.—This is a constantly recurring nuisance, and in inspecting it is necessary always to ascertain the number of occupants of every room in every sub-let house. It is not always possible to get a correct statement from the occupant of any particular room, but enquiry of another occupier in the same house will frequently elicit not only the number living in a particular dwelling, but the number in the whole house.

* The Lecture was illustrated by diagrams, plans, sections, &c.

Corroboration is valuable in securing accuracy. The number and size of the beds are strong evidence. The size of a room need not always be exactly measured, with a little experience it may be mentally calculated with sufficient approximation for practical purposes. With this object in view the method of calculating area and capacity must be practised. It is well always to notice the number of air inlets and outlets in a room, and the situation and use of the door, window, and fireplace. The open space about the house itself should also be noted.

Smoke also requires special care in observation. For this purpose a diagram of smoke shades is useful, so that an idea of the density of the smoke may be conveyed to others in giving evidence, and as a permanent record. In making observations of smoke the following points must be noted. The date and time of day. The description of the premises upon which the chimney is situated, and the use to which the furnace or fireplace is put. The kind of sky or background against which the smoke is seen issuing. The density and variations in the density of the smoke according to corresponding numbers on the diagram. The duration in minutes of the prevalence of each particular shade of density. Furthermore, you must distinguish smoke from steam, or steam and smoke mixed. If the density and duration of the smoke be sufficient to constitute a marked nuisance, do not fail to enquire who has charge of the furnace at the time. The construction of the furnace and the quality of the fuel used are questions rather for an engineer.

Dangerous Infectious Disease.—In making an enquiry of this kind, in addition to the information contained in the Notification Certificate, the following facts should also be ascertained. Where the clothes are washed; whence the milk supply is obtained; the occupation of the patient; the school, workplace, or office attended, and date of last attendance; the date of the beginning of illness and the appearance of rash (if any); the probable source of infection. (For this purpose you should carry a table of the maximum, minimum, and mean incubation periods of the various diseases.) The room occupied by the patient, whether it is a bed-room or a living-room; other occupants of the room, and the name and address of the nurse or attendant and other duties of the attendant. Precautions taken to isolate the room and the patient, and if improperly isolated whether the medical attendant considers removal to hospital inadvisable, and if so, why? if removed, to what hospital and on what date; if not removed the probable date when disinfection will be required. (A table of the average duration of infectiousness in the various diseases is useful for this purpose. If intimation can be obtained from the medical attendant directly,

or indirectly through the person in charge, this is still more useful.) A record of the sanitary condition of the premises must be made, and the house inspected in detail as to the number of persons occupying each portion of it, their occupation, and the work-place, or school attended. In the case of Small Pox the Vaccination Officer must be notified. If the infectious sufferer be a child notification should be sent to the teacher of the school attended by the patient. The principal points of these details, in addition to the particulars on the Notification Certificate, should be kept consecutively in an Infectious Disease Register so that all essential references to any particular case may be seen at a glance.

Sampling Water.—As another illustration, it is frequently necessary in rural districts to ascertain the quality of the well water. For this purpose a sample of the water must be taken. The best method is to use a Winchester quart bottle, equal to a half gallon, with a ground glass stopper. The bottle should be well cleansed and prepared by being rinsed with hydrochloric or other acid, and then be rinsed several times with water until the drippings are no longer acid to the tongue and taste, and at the time of use, rinsed with the water to be sampled. The bottle should then be filled with the water within an inch or so of the neck, the stopper inserted and tied down securely. Sometimes a luting of linseed meal or clean clay is laid round the stopper; but an india-rubber cap over all is the best. It should then be sealed, and securely packed in straw or hay in a wicker basket for transport.

Sampling Food.—Another instance, under the Sale of Food and Drugs Adulteration Act you must be familiar with the usual procedure. A sample is purchased in the ordinary way by yourself or by an agent. After paying for it, the vendor is informed for what object it has been purchased. Divide the sample into three parts; securely fasten and seal each part and number and letter them, taking note of the number and letter, and of the name and address of the vendor. Offer one of the parts to the vendor, take the other two parts away, sending one to the analyst and retaining the other to be produced in court if a prosecution be necessary. For the purpose of sampling, proper bottles and tins with labels attached must be carried in a bag, which should also contain a special notebook. The quantities necessary to be purchased are about a pint of milk, or a pound of butter, and other substances in proportion, but an ounce or two of condiment is sufficient. In sampling milk or other food in transit it is necessary only to take the sample without dividing it: but, in case of prosecution it is necessary for the consignee to give evidence as to what he had contracted

to buy. Possibly the contract may have been for skim milk, for instance.

Unsound Food.—The method of procedure in the case of unsound food must not be confused with that of adulterated food. The unsound food may be an animal intended to be prepared for food, or any article, solid or liquid, intended for the food of man. Be quite satisfied in the first place that it is intended for food, and in the second that the food is unsound, and then seize it at once. After seizing it, if still in doubt the opinion of a colleague at hand may be asked, or the Medical Officer of Health be consulted. The food or a sample of it, if bulky, is then taken to a Justice who will condemn it, order its destruction, and issue a summons when necessary. It should be prevented from being used as food by saturating it with common carbolic acid or creosote, and then be buried or burned.

House Inspection generally.—In considering the inspection of premises it may be well to first give a general idea of the inspection of an ordinary house. First observe, externally, the access of light and air, the open space around, whether it is properly levelled and drained, and the guttering and roofing. Note any animals kept and their condition, any offensive accumulation, ditches or stagnant water, and whether any offensive trade is carried on or any effluvia is produced. Within the house, note any dampness, especially in garret or basement, the absence of any dry area or damp course, whether the basement is impervious and if there is any ventilation below the floor, and any underground sleeping room. In staircases, passages, and rooms, observe the soundness and cleanliness of the surfaces generally. In the last, the structural and decorative condition of the surfaces, the cubic capacity, and the number and ages of the occupants, and the purposes for which occupied. The points of lighting and ventilation must also be attended to. In reference to water-closets their number, situation, ventilation and cleanliness should be noted, the efficiency of the apparatus and the mode of water supply. The soundness, disconnection and ventilation of the house drain, the disconnection of waste pipes, overflow pipes, rainwater pipes, and the situation of gullies, the absence of receivers and cesspools. The wash-house floor should be smooth, sloped and drained, and the waste cut off. It should be ascertained whether the water supply is constant or intermittent, and whether from a main or from some other source, and the capacity, situation and cleanliness of the cisterns must be noted, and the course of the overflow and supply pipes therefrom. The ash receptacles will require attention, and, where dry systems of excreta-removal prevail, also the ash or dry earth-closet.

Before speaking of premises in detail it will be well to give a few approximate definitions, the legal definitions are generally lengthy and complicated, but the following are useful to the practical understanding of certain points. Places of human habitation not only include places used for dwelling purposes, but also those used for other purposes of habitation. A dwelling is generally held to be so constituted by the act of sleeping, or of passing the night with intent to sleep. A building is a structure partly or wholly enclosing cubic space, and more or less permanently attached to the soil. A house not only includes a dwelling house, but also any building capable of being used for habitation. The curtilages and appurtenances attached to a house, wholly or partly used as a dwelling, are generally held to form part of the house.

Dwellings.—In classifying dwellings they may be regarded as movable or fixed. Movable dwellings include canal boats on water; tents, vans, and sheds on land. Fixed dwellings include hop and fruit pickers' dwellings, cottages and huts, and larger houses.

Canal Boat Dwellings.—In inspecting a Canal Boat the points to be noted are :—Is it a Canal Boat? With the exception of ships registered under the Merchant Shipping Act any vessel, however propelled, for the conveyance of goods along any inland water way within the body of a country is a Canal Boat. It must be ascertained whether it is used as a dwelling, and, if so used, if it is registered. If registered, the word "registered," the name and place of registration, the registered number and the name of the boat should be found conspicuously painted on both sides of the cabin on the stern, so as to be plainly seen from both sides of the canal. If properly lettered and marked the master's certificate should tally, and state the maximum number of persons allowed in the dwelling. It should be ascertained that the dwelling is properly used. A cabin is not allowed to be occupied as a sleeping place at any time by a male over 14 and a female above 12 years, unless husband and wife. A cabin occupied as a sleeping place by husband and wife is not allowed to be occupied as a sleeping place by a male above 14 and a female above 12. There must be 40 cubic feet of free air space for each person under 12, and 60 cubic feet above 12. In a "fly" boat (worked by shifts) 180 cubic feet is required for two persons occupying a cabin at the same time as a sleeping place. These conditions are modified slightly for boats built before 1878. In inspecting a Canal Boat *for registration* the following conditions must be looked for :—That there is at least one dry clean weather-proof cabin in good repair. That the capacity of the after-cabin be 180 cubic feet

and the fore-cabin 80, if intended to be used as a dwelling. That sufficient means are provided for ventilation in addition to the door. That adequate and convenient sleeping accommodation is fitted or constructed. That one cabin is fitted with a suitable stove and chimney. That a suitable tank for storing at least three gallons of water is provided. And, that if used for offensive cargo, a cabin used as a dwelling is separated by two bulk-heads, four inches apart, of which that next the cabin is water-tight, and the space between, open to the air and supplied with a pump. There are one or two other less important requisitions as to narrow and wide boats. A "narrow" boat is less, and a "wide" boat more than 7 feet 6 inches across. Any structural alteration voids the certificate. For the purpose of inspection the hours are from 6 a.m. to 9 p.m.

Movable Dwellings.—In reference to tents, vans, sheds, and similar structures it must be noted whether they are kept in a cleanly and habitable condition. That no nuisances arise in connection with them, and that no infectious disease is nursed therein. Under the Housing of the Working Classes Act, 1885, section 9 (2), the sanitary authorities may make bye-laws for this class of dwelling, and it is generally provided that they shall not be erected within 100 yards of a street or dwelling-house.

Hop Pickers' Lodgings.—The points for inspection and observation here are:—That the habitation is clean, dry, and weather proof, and is ventilated and lighted. That a floor space of 15 square feet is allowed each occupant, children under 12 being allowed one-half. That clean straw or other suitable material is supplied for bedding, and renewed when required. That the beds occupied by adults of different sexes are separated by a screen. That there is a sufficient supply of good water. That there is a separate cooking place for every 15 persons. That there is adequate privy accommodation for each sex. That immediately before occupation the premises and accessories have been thoroughly cleansed, and during occupation are kept cleansed.

Vegetable and Fruit Pickers' Lodgings require similar regulation and supervision.

Cottage Dwellings.—These are mainly to be found in rural districts but exist also in towns. Dampness, pollution of surface and of subsoil water are the great troubles here, and may be briefly considered under the heads of construction, refuse removal, and water supply. In addition to the general state of repair they must be kept wind and water-tight. In a waterlogged soil subsoil drainage may be necessary. A ventilated

space between the floor and the earth, or a basement layer of concrete, are things not generally found. There should be an absence of earth or refuse matters against the outer walls, and a dry space, or area, 3 feet wide from 6 inches below the level of the floor upwards may be required. If then the walls require support this should be filled in with rubble, or the area may be arched over in places. Of course in new cottages a proper damp course would be inserted above ground level. In some cases it is desirable also to pave the surface outside for a distance of a few feet from the walls. Proper guttering and piping to carry off the rain water must be provided. The windows should be made to open properly, and the place where the food is kept should ventilate into the open air. The slop water should be cast into a proper sink, with the waste cut off and delivering into a culvert or drain which should deliver upon the land at a distance. There should be no sunken pit for excreta or refuse, but a proper ash or earth closet above ground, and the receptacle should preferably be movable rather than fixed, but in any case it should be impervious. Cesspools should on no account be permitted near a cottage. The object of cesspools is to intercept and retain solid excreta, but solid excreta should not be permitted to enter drains unless there is a proper sewerage system, and then cesspools are not necessary. In a rural district with available land, cows, pigs, and other animals should be kept at some distance. The manure should be heaped, away from the vicinity of the dwelling and of the well, and the surface of byres should be properly drained on to land, not into a stream or pond. The water used in cottages may be either rain water, surface water, well water, or high pressure water from the main. The surface from which the rain water is collected, and the receptacle in which it is kept should be observed to be cleanly and constructed of proper material. Surface water unless it comes from good grass land, moor land, or high uncultivated land is objectionable. Well water, if derived from a shallow well is open to suspicion, and its pollution is one of the commonest troubles of cottage dwellings. The only remedy then is to sink a properly steyned deep well, or to lay on a high pressure water supply from a main.

Larger Dwelling Houses.—Turning now to the larger type of dwelling houses, it is not necessary to take into consideration the duration of tenancy, whether nightly, weekly, monthly, or quarterly, but the external relative position and the internal relative occupation are most important points.

The External Relative Position of Dwelling Houses influences the number of fronts, whether they be 1, 2, 3, or 4. Taking the ordinary dwelling house to be constructed in rectangular form, houses are generally described as detached, semi-detached,

or terrace houses. These have respectively four, three, and two fronts, the two fronts of the last being on opposite sides. If these houses back immediately upon one another they form respectively semi-detached, four-group, and back-to-back houses, possessing three, two, and one front respectively. In a four-group house the two fronts, unlike those of the terrace house, are on contiguous sides, just as in corner houses formed at the return angles of a block of terrace houses. In the house with one front there can be no perflation of air, and in a house with two fronts on contiguous sides only a partial and diagonal perflation. This applies to four-group houses and corner terrace houses. The construction of back-to-back houses of more storeys than one intensifies their objectionableness, as the room below ventilates into the room above by means of the open staircase, and this is not even overcome by the enclosure of the staircase and the insertion of windows, if the house be occupied by several families acting independently. But a still greater drawback to this class of house is the absence of proper curtilage or open space for the deposit of refuse receptacles and for other domestic purposes.

The Internal Relative Occupation of Dwelling Houses is dependent upon whether they are constructed for one or many tenants, and they may be classified somewhat in this manner:—

1. The house constructed as one dwelling, that is a self-contained house, which has been altered into a house let in separate lodgings (in which class of house the underground lodging or dwelling is generally found), or into the common lodging house.

2. The house constructed in separate dwellings, known as the common-stair house or model dwelling house, and which is large or small according to whether it is constructed as a common-stair block or a cottage block.

3. The house constructed as a common dwelling for many occupants, examples of which are the model common lodging house, and the shelter or refuge.

4. A special kind of dwelling house constructed to harbour animals and lodge human beings, namely the stable dwelling.

Houses Let in Separate Lodgings, Tenements, or Dwellings require continuous supervision by the sanitary authority. To facilitate this they are in many cases registered under bye-laws. The special point to be noted is that under these bye-laws the landlord is made liable for structural repairs, the maintenance of the drainage and means of ventilation, and the cleansing of all parts of the premises used by two or more tenants, whilst the tenant is held responsible for the

management and cleansing of his own rooms, and the parts of the premises used solely by him. In addition to the ordinary conditions and requirements of a dwelling house the points to be observed during inspection are :—That at least 300 cubic feet of air space is allowed each person in a sleeping room, and 400 in a room used for sleeping and any other purpose. Children under 10 years of age are generally allowed half this amount, although children are far more susceptible to the effects of want of fresh air than adults. That every sleeping room is perflated daily by an open window for an hour or two, whenever possible. That the cisterns are kept cleansed. That one closet at least is provided for every 12 persons, and is kept clean and in good order and repair. That the ash receptacles are dry and clean, and in good repair, and contain no wet refuse. In reference to the state of cleanliness of the rooms, that the refuse matters, liquid and solid, are removed daily and the receptacles cleansed, and that the surfaces are kept clean, and the floors swept daily and washed weekly. As regards the cleansing of the house, this is done annually by whitewashing or washing where required, and renewing the paint when and where necessary. That no animals are kept so as to render the premises filthy. That yards and open spaces are clean and in good order, and the former properly paved and drained. Lastly, that the presence of infectious sickness is immediately reported.

It is generally in this class of house that *underground dwellings* exist, that is to say, any underground room let separately as a dwelling, the floor of which is more than three feet below the adjoining ground level. In inspecting such a dwelling to ascertain whether or not it is illegally occupied, it should be noted whether there is a bed in the room, and whether the room is let separately from any other room in the house, except an adjoining front or back underground room. It must be ascertained whether the cellar is seven feet high and whether it is three feet above the nearest ground level. If there be outside, and along the entire frontage, an open area two feet six inches wide, and whether the surface is six inches lower than the floor level. Whether the room is effectually drained. If there be the use of a closet and ash receptacle, and whether the room has a proper fire-place and flue, and an external window nine feet square, the upper half opening, or in the case of a back cellar half this size. Remember that steps for access to the cellar, and other means of access to any dwelling above, are allowed in or over the area provided they do not block the window. In addition to these requirements, in London there are others, although it is in the power of the sanitary authority

to modify them. The principals are, that there is a proper damp course in the walls, that the area is properly paved, that the space beneath the floor (if any) is ventilated into the outer air, and that the room is secure against the rising of exhalations. It is extraordinary that the last two, especially the former of the two, should have been omitted from the requirements of the Public Heath Act, 1875. Even now there is no provision, as to the other side of a back area, that is to say beyond three feet of the house, to prevent the erection of high structures that may block out practically all light and air from the dwelling. This is a condition of things very commonly found in the metropolis.

There is another kind of lodging-house very similar to those just mentioned, namely, *seamen's lodging-houses*, and the Sanitary Authority of a seaport town, with the sanction of the Board of Trade, may make Bye-Laws and Regulations for licensing, inspecting, and for the sanitary condition of these. It is unnecessary to give such conditions in detail. They may be sufficiently appreciated from what has been already said in reference to other lodging-houses.

The Common Lodging House invites our attention next. This is a house kept for profit, in which sleeping and other accommodation is provided, more or less in common, for strangers, at a charge of a few pence per night. Here upon inspection you will ascertain, firstly, that the conditions of wholesomeness needed for dwelling houses in general are observed, and, secondly, that it possesses certain conditions in particular. You will look first for the words "Registered Common Lodging House" affixed outside, and inside for a copy of the Bye-Laws with respect to Common Lodging Houses affixed in a suitable and conspicuous position. In each room you will observe that a placard is affixed in a conspicuous position, stating the number and description of the room, and the maximum number of lodgers authorised to be received into it at one time With regard to the furniture, that the number of beds and utensils sufficient for the maximum number of persons allowed is supplied in each room. With reference to the separation of sexes, it must be seen that only one male occupies each bed, that no male over ten years of age occupies a room used by females, that no female occupies a room used by males above ten, excepting a room set apart for married couples, in which case you will see that a wooden partition is fixed from six inches above the floor to a sufficient height above each bed, so as to act as an effectual screen. As to cleansing, note that the beds and bedding are kept clean and wholesome, and aired daily, vessels cleansed daily, all floors and stairs swept daily and washed weekly, and all

surfaces of walls, furniture and effects kept cleansed, and that cleanliness and ventilation generally are maintained. That sufficient water is supplied for washing in basins, and that these as well as the towels are kept clean. That the sanitary conveniences, ash receptacles, and open spaces, are kept clean and in good order. When inspecting a house *for registration*, in addition to the ordinary conditions of wholesomeness, it should be specially observed that the ventilation is good, and that the bed rooms have proper ventilators and are above ground, that the kitchen accommodation is proper and the water supply sufficient, that there is one closet for at least every twenty lodgers, that there are sufficient ash receptacles, and that the washing accommodation is sufficient and separate from the bed rooms.

Another class of common dwelling, that has been brought more into prominence by the Salvation Army, is *night shelters* and *refuges*. Air space, ventilation, and cleanliness are much to be desired where human beings are closely congregated in buildings put to such use. The conditions are those of common lodging-houses, in fact rather more acute, but not being kept for profit it has been ruled by the Courts that they cannot be registered as such.

Common lodging-houses have hitherto been ordinary dwelling-houses converted to that use, and in the majority of instances are ill-adapted for the purpose. Glasgow led the way in the matter of improvement, but recently some improved models have been erected in London and are worthy of a visit, namely, the common lodging-house of the London County Council, Parker Street, Drury Lane, and Lord Rowton's Lodging-House, Bond Street, Vauxhall, the latter is even better appointed than the former.

In a similar manner the conversion of ordinary dwelling-houses constructed for one family to the use of many has been partly superseded by a number of large buildings specially constructed in separate dwellings. The conditions of construction required in this class of buildings are not even now settled, although there are certain points that are desirable. The limitation of the height of the building to about five storeys. The proper lighting of such dwellings, so that above lines, drawn from the bases of the rear and fore fronts, at an angle of 45° upwards, that is, half-way between the vertical fronts and the horizontal ground level, there should be no obstruction to light and air. All the habitable rooms should possess through ventilation. The minimum height of rooms nine feet, and the minimum area 144 square feet for living, and ninety-six square feet for sleeping rooms. On each floor there should be sufficient and proper

water supply, and a sufficient and proper number of water-closets. In new dwellings to be erected the latter should be cut off by a disconnecting lobby open to the external air, and they are best situated one above another in a tower. This is important, because such buildings are constructed on the flat, often in such a manner that the apartments communicate directly or indirectly with each other, having no ventilated staircase, well to separate them as in an ordinary house. The different manner in which various dwellings of this type are occupied render it difficult to generalise as to the exact details of arrangement and construction, but the addition of a balcony or open space, attached to each dwelling, or on each floor, for exclusive use, is a great advantage sanitarily.

It is held by many that these large blocks of dwellings are objectionable, and that smaller houses or cottage blocks should be erected. The immense value of land in the centre of cities militates against this, but outside this area a number of cottages or smaller dwellings for one, two, or three families have been erected in such a manner as to dispense with a common staircase. There is no reason why the Bye-Laws for houses let in lodgings should not be applied to dwellings of these last two types if necessity demands, but the occupants are generally of a provident and careful class, and a resident caretaker exercises constant supervision.

Stable dwellings of old date, and some of more recent, are in the majority of cases extremely objectionable in construction and arrangement, and you will experience some difficulty in remedying the objectionable conditions. However anxious you may be to remove gullies from outside dwelling houses you will find these invariably to exist inside stables, and the rooms over the stable are mostly entered by a staircase through the stable, so that dwelling over a stable is only an apology for dwelling in a stable. The effluvia produced by the animals, and by their excreta (which is frequently allowed to accumulate), ascend. The closet is usually situated under the stairs, and is seldom lighted or ventilated. Frequently the back dwelling rooms in the loft above have no proper skylights. These are matters which will require your attention to remedy, by proper outside manure-bins, and proper light and ventilation to closets and back rooms, and cleanliness generally. The ventilation of the stable may frequently be improved by the insertion of air bricks in the back wall, for stables are generally in the same condition of relative position as back to back houses, having only one front.

It is almost unnecessary to advise you that when you discover dwelling houses grossly unhealthy on account of bad construc-

tion and repair, or grossly obstructive dwellings, or an area containing these, it is your duty to report the fact to the Medical Officer of Health for the purpose of putting the Housing of the Working Classes Act into force.

I must now direct your attention to certain classes of professional and trade premises. *Schools* require inspection from time to time. The area, space, and ventilation of the class rooms, and the situation and condition of the W.C.'s and drainage are points to be observed in all schools, whether day or residential. In the latter the ordinary sanitary conditions of a dwelling house are required in addition.

Factories, premises upon which steam, water, or other power is used for manufacturing, are under the supervision of the Factory Inspectors. But the supervision of *Workshops* now falls within the duties of Sanitary Inspectors. A workshop includes any premises, room, or place within which any manual labour is exercised for the purpose of gain, and over which the employer has a right of access. You will observe that the use of power converts the premises into a factory. A *Domestic Workshop* is a workshop in a private house, room, or place that is used as a dwelling, and in which the only persons employed are members of the same family dwelling there. Bakehouses and Laundries are also regarded as Workshops. A *retail bakehouse* is any bakehouse or place in which the bakings are sold by retail in a shop or place occupied together with a bakehouse. It does not include wholesale bakehouses or baking factories. There is no special definition of a laundry.

You have power to inspect by day any place believed to be a *workshop*, and by night when any person is believed to be employed there, night meaning from 9 p.m. to 6 a.m. The points to be observed in inspecting are:—That the place is in a cleanly state. That the walls and tops of rooms, passages, and staircases are limewashed, or, if painted and varnished every seven years, are washed at least within every 14 months, and at other times when necessary for health. That no effluvia arise from excremental sources, or other nuisances dangerous to health. That it is not overcrowded, and is so ventilated as to render all impurities generated therein harmless as far as practicable. That if any child under 14, young person 14 to 18, or woman over 18 years, be employed it be reported in order that the Factory Inspector may be informed. That lists of out-workers are properly kept, notes of these should be taken. That the sanitary conveniences are sufficient, especially with regard to number, and that there is separate accommodation for each sex. It is common to find these in the form of latrines, trough-

closets, and urinals, and it should be ascertained that they are properly attended to at frequent intervals.

In regard to *Bakehouses* they are not only subject to the requirements of workshops generally, but there are certain special requirements of which particular note should be taken. They are:—That all the inside walls and tops of rooms, passages, and staircases are either painted or varnished or lime-washed. That, if the former, painted in oil of three coats and renewed every seven years and washed every six months; if the latter, limewhited at similar half-yearly intervals. That no place on the same level, which is part of the bakehouse premises, is used as a sleeping place, unless completely partitioned off, and possessing a window nine feet square, one-half opening. That there is no receptacle for excreta, or liquid, or solid refuse, within or communicating with the bakehouse, and that the cistern supplies no closet directly, and generally that the bakehouse is not unfit for use or occupation. If unfit the bakehouse cannot be compulsorily closed, but the offender can be fined until it be brought into conformity with the requirements of the Act. In London and other large towns numbers of bakehouses are situated underground, a condition of things which entails the enclosure of cellars, yards, and areas, the consequent exclusion of light and ventilation, and the placing of refuse receptacles and solid refuse as well as drain openings within or near the bakehouse, from inability to place them elsewhere. Unfortunately the regulation of bakehouses appears only to have contemplated the protection of the health of the workers therein, and to have overlooked the protection of the food, especially after it has left the ovens.

Slaughterhouses.—In inspecting slaughterhouses it is necessary to ascertain that the slaughterhouse premises have been licensed by the authority, and that the license has been duly registered. You will then proceed to ascertain that water is supplied to every animal in a lair previously to slaughtering. That there is proper means for securing the head of cattle to avoid suffering. That the ventilation, drainage, and water supply is in proper order and efficient. That the quantity of water especially is sufficient for cleansing purposes. That the walls and floor are in good repair so as to prevent absorption, and are cleansed within three hours of slaughtering. That all the internal surfaces are hot limewashed every three months. That no dog is kept in the slaughterhouse, nor any other animal except such as is intended for slaughter. Dogs are specially excluded because they harbour a tape worm (tænia echinococcus) the cystic form of which (echinococcus hydatid) becomes parasitic in both ruminants and man. That animals are kept no longer than is

necessary, and only in the lairs. That non-absorbent vessels with tight covers are provided and cleansed, and that all refuse matters are placed in them forthwith and removed every 24 hours. Similarly that all skin, fat, and offal are removed within the same period. In inspecting slaughterhouses previous to *registration* for the purpose of granting a license certain other points must be observed, namely: That the premises are not within 100 feet of any dwelling house, and are open to the air on two sides. That the floor of the slaughterhouse is not below the level of the ground, and that the approach is not through a dwelling house or shop, and not inclined more than one in four. That there is no room or loft over. That an ample receptacle for water is provided, the bottom of which is not less than 6 feet above the floor level. That there are means of thorough ventilation. That the floor is well paved with impervious material sloped towards a properly-trapped gully. That the inside walls are covered with a smooth impervious material to a sufficient height, say 5 or 6 feet. That no possible source of effluvia communicates with the slaughterhouse, and that every lair is properly drained, paved, and ventilated, and has no habitable room over.

Dairies, Cowsheds, and Milkshops are controlled under Orders of the Local Government Board, dated 1885 and 1886. These Orders have been made under the Contagious Diseases (Animals) Act, 1886, and it is compulsory for Dairymen to be registered and for the Sanitary Authority to keep a register. Furthermore, new dairy premises must be constructed to the satisfaction of the Sanitary Authority, and old buildings cannot be occupied unless they provide for the health of the cattle, cleanliness of the vessels, and the protection of the milk. An infected person, or one who has been in contact with an infected person, is not permitted to take part in the business. No receptacle for excreta may communicate with a dairy building, nor may the building be used for sleeping, or other improper purpose, and swine are not to be kept in it, and the milk of a diseased cow suffering from pleuro-pneumonia, cattle plague, or foot-and-mouth disease, is not to be used for human food, nor, unless boiled, for the food of animals. This Order makes it permissive for the Sanitary Authority to make Regulations, and in such Regulations the points usually provided for, and that will require the attention of the Sanitary Inspector, are:—That the *Cowshed* is sufficiently lighted. That the ventilation is thorough, and preferably by louvred ventilators inserted in a lantern roof. That each cow is allowed 800 cubic feet of air space, or 600 with perfect ventilation, any height above sixteen feet not being taken into account. That each cow has a superficial

space of eight feet by four, or two cows in one stall eight feet by seven. That the shed is properly paved with impervious material, sloped to a channel terminating at a trapped gully situated outside where practicable. That a properly covered tank, kept cleansed, and containing at least twelve gallons of water for each cow, is provided, the bottom being at least six feet from the floor, and the overflow disconnected. That each stall is provided with a water trough of impervious material, supplied by a proper pipe, and emptying by a proper waste. That the walls, doors, etc., are covered with an impervious material to a height of five or six feet. That impervious receptacles properly drained are provided outside the cowshed for grains and also for dung, and that they are not kept inside. That the upper part of the inside surface is cleansed and lime-washed every six months, and the lower five or six feet as frequently as necessary. That the floors and troughs are cleansed twice daily with water, the dung and offensive litter removed, and that all milk utensils are scalded or steamed as frequently each day as necessary.

With reference to *Dairies*, the lighting and ventilation must be sufficient and thorough, the inner surface of the walls of impervious material to a height of 5 or 6 feet, the floor properly drained and sloping to an opening leading to a properly trapped gully outside; for water, a properly covered tank, periodically cleansed, and of sufficient capacity, must be provided, the overflow discharging into the open; the upper parts of the buildings must be cleansed and lime washed, the lower parts of the walls, fixtures, and floors must be cleansed, and the milk utensils scalded or steamed as frequently as may be necessary to keep them cleanly. In *milk shops* it should be noted that the fixtures are kept in clean condition, that the milk utensils are thoroughly cleansed with boiling water or steam as frequently as may be necessary, and that the water supply is pure. To prevent infection or contamination it should be seen that immediate notice is given of infection amongst the employés or their families. In case of infection, all milk and utensils should be immediately removed from the infected building and thoroughly cleansed, and not replaced until the building itself has been thoroughly disinfected and cleansed. Offensive effluvia should be guarded against by providing that no milk or utensils are kept in any place where they are likely to arise.

Offensive trades and nuisances are dealt with in other lectures, therefore I will conclude with a few words as to equipment. It is useful to carry official visiting cards, and also a small official certificate of appointment and power of entry bearing the seal of the authority, although it may be rarely

required; also a few forms for taking verbal complaints when on duty, upon which should be entered the date, the name and address of the complainant, the subject and locality of the complaint, and your own signature. These can be entered in the complaint book at the office subsequently, and be careful to preserve these forms, as well as all letters of complaint, to defend yourself against any possible charge of spite or excess of duty. Also forms for enquiring into infectious cases, forms for the inspection of dwelling-houses, for underground dwellings, &c. These, probably, you will find already drawn up for you by the Medical Officer of Health, and the various office books necessary will also be arranged by the Clerk to the particular Authority in conjunction with him; but you will always carry with you a pocket note book, and from it transcribe your daily work into your diary or journal. You will also require certain appliances. For testing drains: odour tests, in bottles or tubes; smoke tests, cases or a machine; exploratory tests, tools and labourers for opening up; elastic plugs for the hydraulic or water test; and a level for gradients. For measurement: a foot rule, a long tape measure (one chain or 66 feet), measuring rods (5 or 6 feet laths, marked to feet and inches). For smoke, a diagram of numbered shades. For meat and other food, perhaps a lens. For sampling, bottles, tins, &c., a special note book, and a bag. For disinfection, vaseline for metal surfaces, gummed paper for chinks, brown paper for fire-places, pans for sulphur or bleaching powder. The Authority to be properly equipped must provide certain accommodation, an infectious hospital, an ambulance, disinfecting vans, a disinfecting chamber and destructor furnace, and a temporary shelter; also an infectious and a general mortuary, a post-mortem room, and a Coroner's court.

Fully equipped in knowledge and appliances, it remains with you to perform your duties to the Public, the Authority, and the Medical Officer, faithfully and discreetly, combining the *suaviter in modo* with the *fortiter in re*.

REPORT OF A SPECIAL COMMITTEE OF THE INSTITUTE

On the Quantity of Water Required to Flush a Water-Closet, and on the Regulations Restricting the amount to Two Gallons.

Adopted by the Council, Nov. 1st, 1893.

YOUR Committee have to report, with reference to the question of the regulations under the Metropolis Water Act, 1871, restricting the quantity of water discharged from flushing cisterns for closets, that they have had before them, and considered in their bearing on the point, the following papers:—

1. The Metropolis Water Act, 1871.
2. The Report of the Commission appointed by the Board of Trade in 1872, and the evidence given before that Commission.
3. The Regulations made August, 1872, by the Board of Trade, under the Metropolis Water Act, 1871, which were based on this Report.
4. The Regulations in force in other large towns.
5. The correspondence on the subject from the Vestries of St. Giles, Islington, Paddington, Shoreditch, Marylebone, and St. Saviour's, Southwark.
6. The Correspondence from the seven associated Water Companies and from the Kent Waterworks.

The Committee have also attended at Deptford and at the New River Head, and witnessed demonstrations given by the Kent Waterworks Company and by the seven associated Water Companies. The Committee have further arranged and carried out a series of over 800 experiments, specially directed to the question under consideration.

In order to come to a reliable conclusion, it is, of course, essential, as pointed out in the communication from the Water Companies, to attend to the following matters:

(a). The suitability of the flushing-cistern and water-closet on which observations are made.

(b). The proper arrangement of the two, with regard to flush-pipe and connections.

These matters were carefully observed in the experiments made by the Committee.

The points that have to be considered with regard to the efficacy of a certain amount of flushing-water are :—

First.—The effect of the flush in removing the matters deposited in the closet basin, from such basin and the trap connected with it.

Second.—The effect of the flush in clearing the drain.

Third.—The effect of the flush in clearing the disconnecting trap.

Description of experiments. The general arrangements are shown in the sketch at the end of the Report, marked E.

The special experiments for this purpose, alluded to above, were arranged as follows (see also Sketch plan) :—

A series of drains was laid 50 ft. in length, partly pipes and partly half-pipes or open channels, of the following sizes and gradients :—

4 in.	1 in 30	6 in.	1 in 30
,, ...	1 ,, 40	,, ...	1 ,, 40
,, ...	1 ,, 75		

At the head of each drain was fitted a simple short hopper basin of a good type, with an "S" trap having a 2-inch seal, leading with a bend into the drain, the top of the closet basin being 2 ft. 3 in. above the drain. A good Siphon Waste Preventer, discharging two gallons in 5 seconds and three gallons in 7 seconds, was placed 4 ft. 3 in. above the closet basin, and connected to the basin with a $1\frac{1}{4}$ in. flush-pipe, care being taken that there should be a clear waterway of this diameter from the cistern to the basin; at the lower end of each drain a disconnecting trap was fixed—two different forms of trap in ordinary use were employed at each gradient. Six hundred experiments were made in this series. Tables A and B and Diagrams A and B show the results of these experiments, first with a two-gallon flush, secondly with a two-and-a-half-gallon flush, and thirdly with a three-gallon flush, the quantity of water in each case being carefully measured.

A further series of drains was laid 26 ft. long, partly pipes, and partly open channels, of the following sizes and gradients :—

4 in.	1 in 40	6 in.	1 in 40

The same closet and waste preventer were used, and the experiments were conducted, as in the longer drains, with two different forms of trap, 240 experiments being tried.

From this description it will be observed that these experi-

ments have been conducted under certain conditions only, with respect to water-closet, flush pipe, application of flush, and gradient of drain. Time has not sufficed to extend the experiments beyond the scope so far adopted, but the Committee think that further experiments on a more extended scale, would be of service in elucidating the entire question.

The method of conducting the experiments was to place in the basin three lumps of artificial excreta (a mixture of soft soap, cocoa fibre, and clay) and five pieces of paper (newspaper). The contents of the flushing-cistern were then discharged, noting in each case how much material was left in the closet trap, how much in the drain, how much in the disconnecting trap, and how much passed through. All the materials were removed before the next experiment. Method adopted

With reference to the materials used in the experiments, it should be observed that they would be more easily flushed out than actual healthy excretal matter.

The results of the experiments are as follows:—

Dealing first with the closet trap, it will be seen from the tables and diagrams that when a large number of experiments is tried (as in the present case, where the average is taken over the whole of the experiments), a two-gallon flush does not always clear the material from the trap, even of a good type of short hopper closet, which clears more easily than any other form of closet. With a two-gallon flush the average amount retained is 5 per cent., and with a three-gallon flush the trap is practically cleared, the retention being only 1 per cent. Closet Trap.

Dealing next with the drain and disconnecting trap, the experiments show little difference between the 4 in. and 6 in. drain and trap, so they may be considered together.

In the case of a drain 50 ft. long, which is an ordinary length when the drainage from the back of the house is taken to a disconnecting trap in front of the premises, and at a gradient of 1 in 40 (3 in. in 10 ft.), a steeper gradient than is commonly used in practice, it will be seen from the Tables B and C and Diagrams B and C,

1. That as regards the drain with a two-gallon flush the retention is 21 per cent., and with a three-gallon flush it is 3 per cent. Drain.

2. That as regards the disconnecting trap with a two-gallon flush the retention is 36 per cent., and with a three-gallon flush 26 per cent. Disconnecting Trap.

In the case of a drain 26 ft. long, which is a common length

of a branch drain from a closet, and at the same gradient as before, 1 in 40, it will be seen from Tables C and D and Diagrams C and D,

Drain.

1. That as regards the drain with a two-gallon flush the retention is 3 per cent., and with a three-gallon flush the drain is practically cleared, the retention being only 1 per cent.

Disconnecting Trap.

2. That as regards the disconnecting trap with a two-gallon flush the retention is 26 per cent., with a three-gallon flush 19 per cent.

In drawing conclusions from the results obtained in these experiments it is important to bear in mind that the light flocculent floating matter containing mucus, which is characteristic of the diarrhœal evacuations occurring in typhoid fever and other infectious diseases, is more difficult to remove from closet pans by flushing than ordinary healthy evacuations, obviously therefore the provision of flushing water ought to be liberal as this will have a direct bearing on the prevention of the spread of diseases in which the infection is found in the evacuations.

THE CONCLUSIONS ARRIVED AT BY THE COMMITTEE ARE AS FOLLOWS:—

Regulations Metropolis.

I. With regard to the regulations made in 1872, it appears from the report of the proceedings before the Commissioners that no evidence at all was given as to the amount of water the waste preventers for closets should discharge in order to fulfil sanitary requirements, the main object in making the regulation about water-closet cisterns being to secure the abolition of the "Stool Cock," which was found to be very wasteful and objectionable. What actually took place was that the Water Companies proposed one-and-a-half gallons, the Metropolitan Board of Works and the City Corporation asked for two gallons, and this latter quantity was readily acceded to by the Water Companies. It should be borne in mind also that sanitary drainage was at that time scarcely understood, and that there was little or no experience as to the amount of flush necessary in order to meet sanitary requirements.

Regulations in other towns.

II. With regard to the regulations in other towns, although in the majority of cases the amount of the flush is limited to two gallons as in London, in several this limit of two gallons is exceeded. In Edinburgh the limit is three gallons, and in Carlisle the amount is unlimited, but must not be *less* than two gallons. This latter case is important as being one in which a minimum is stated.

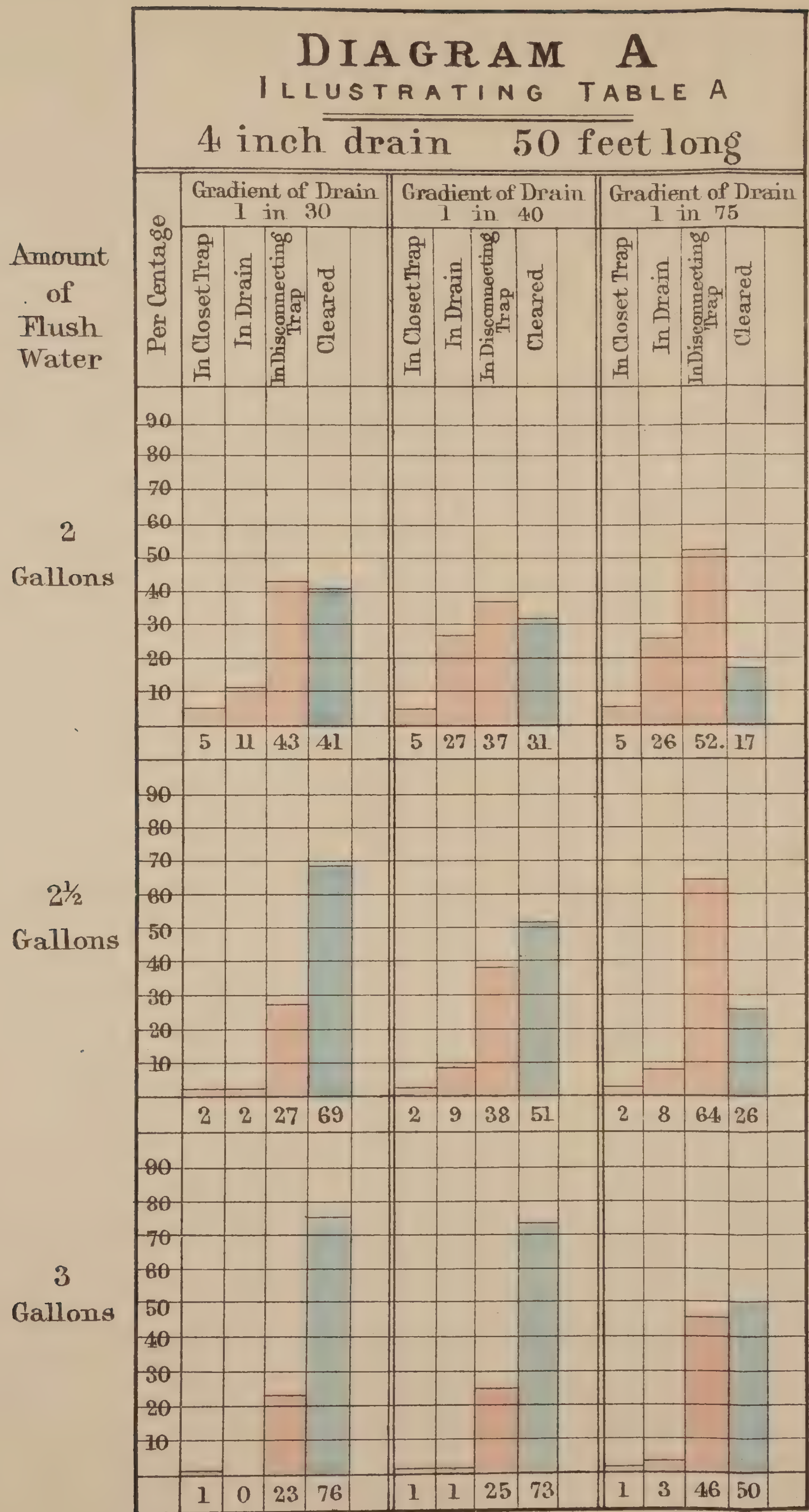


DIAGRAM A
ILLUSTRATING TABLE A
4 inch drain 50 feet long
Amount of Flush Water
Per Centage
Gradient of Drain 1 in 30
Gradient of Drain 1 in 40
Gradient of Drain 1 in 75
In Closet Trap
In Drain
In Disconnecting Trap
Cleared
90 80 70 60 50 40 30 20 10
2 Gallons
5 11 43 41
5 27 37 31
5 26 52. 17
2½ Gallons
2 2 27 69
2 9 38 51
2 8 64 26
3 Gallons
1 0 23 76
1 1 25 73
1 3 46 50

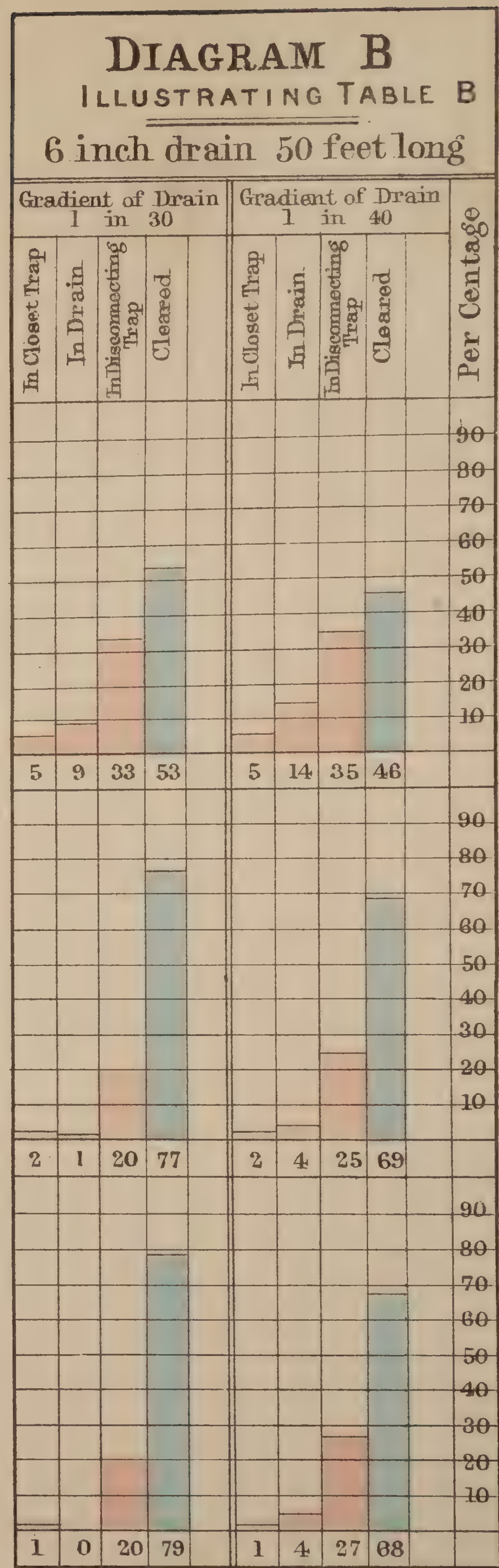


DIAGRAM B
ILLUSTRATING TABLE B
6 inch drain 50 feet long
Gradient of Drain 1 in 30
Gradient of Drain 1 in 40
Per Centage
In Closet Trap
In Drain
In Disconnecting Trap
Cleared
90 80 70 60 50 40 30 20 10
5 9 33 53
5 14 35 46
2 1 20 77
2 4 25 69
1 0 20 79
1 4 27 68

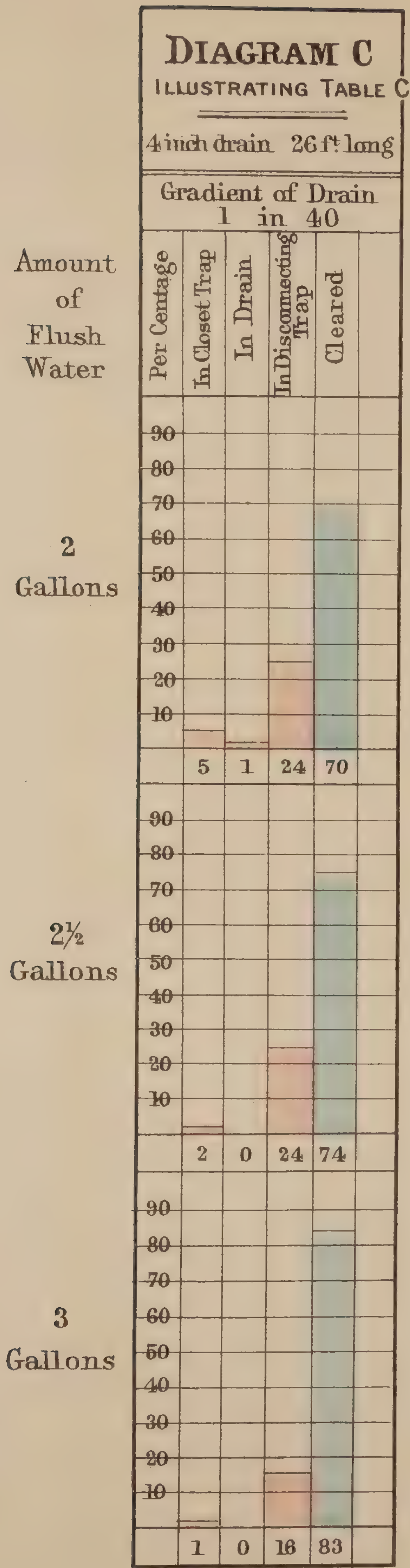


DIAGRAM C
ILLUSTRATING TABLE C
4 inch drain 26 ft. long
Gradient of Drain
1 in 40
Amount of Flush Water
Per Centage
In Closet Trap
In Drain
In Disconnecting Trap
Cleared
90
80
70
60
50
40
30
20
10
2 Gallons
5 1 24 70
2½ Gallons
2 0 24 74
3 Gallons
1 0 16 83

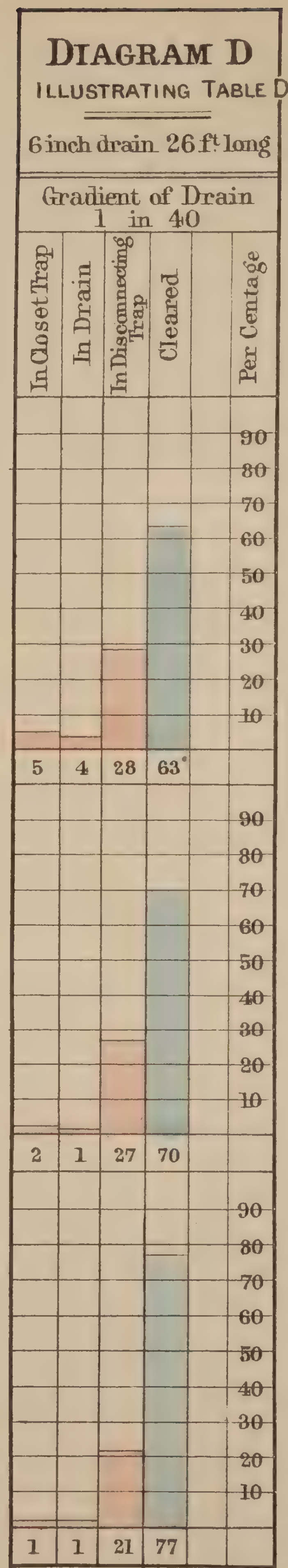
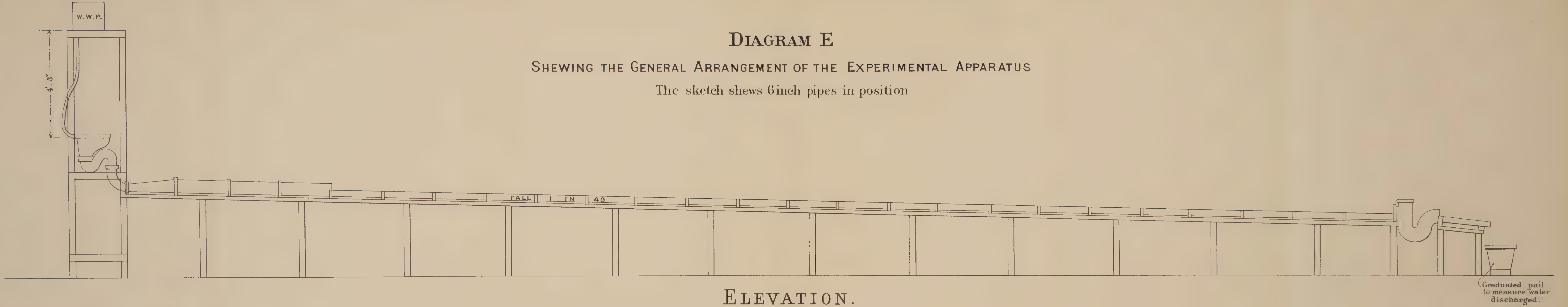


DIAGRAM D
ILLUSTRATING TABLE D
6 inch drain 26 ft. long
Gradient of Drain
1 in 40
In Closet Trap
In Drain
In Disconnecting Trap
Cleared
Per Centage
90
80
70
60
50
40
30
20
10
5 4 28 63
2 1 27 70
1 1 21 77

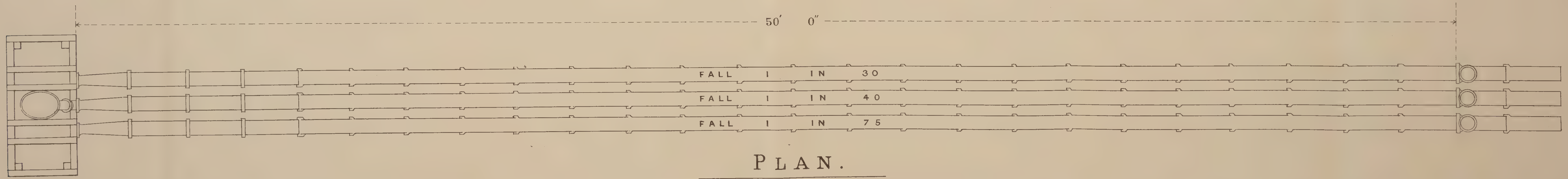
Diagram E

Shewing the General Arrangement of the Experimental Apparatus

The sketch shews 6 inch pipes in position



ELEVATION.



PLAN.

III. As the Council is aware the thirteen Exhibitions which have been held by the Institute during the past sixteen years have given this Committee in their capacity as judges exceptional opportunities of forming an opinion upon Flushing Cisterns and Closets, inasmuch as nearly every variety of apparatus has come under their notice, and has been subjected to a uniform system of tests. The opinion they have formed is that the limit of the quantity of flushing water to two gallons is very undesirable for any kind of closet, and altogether prevents the use of a number of excellent forms of valveless closet, which are in accordance with the By-laws made by the London County Council under the Public Health (London) Act, 1891.

IV. The Committee are of opinion that on sanitary grounds it is essential that a minimum quantity of flushing water should be specified, as the regulations at present in force, which specify a maximum only, would allow the fixing of cisterns holding much less than two gallons.

V. They are also of opinion that it is desirable, in order to prevent waste of water, that a maximum should also be specified.

VI. With regard to the quantity, the Committee are of opinion that two gallons is not sufficient for a minimum, and certainly not for a maximum. It is therefore desirable that the regulations should be altered.

VII. The Committee are of opinion, both from long practical experience and after careful consideration of the results of the experiments described in this Report, that the minimum quantity of flushing water should be fixed at three gallons.

VIII. The Committee are of opinion that the maximum should not be less than three-and-a-half gallons.

IX. It is important for practical reasons that the words "capable of discharging," which occur in the present regulation, should be altered, and they would suggest that Clause 21 of the Regulations under the Metropolis Water Act, 1871, should be altered to read—

> "So constructed, as to discharge *not less than three, nor more than three-and-a-half* gallons of water at each flush."

ERNEST TURNER,

Chairman of the Committee.

E. WHITE WALLIS, *Secretary.*

Oct. 30*th*, 1893.

TABLE A.—*Showing Results of* 360 *Experiments with* 4-*inch Drain Pipes and Channels. Drain* 50 *ft. long.*

Amount of Flush Water.	Gradient of Drain, 1 in 30. Percentage of Total Materials.				Gradient of Drain, 1 in 40. Percentage of Total Materials.				Gradient of Drain, 1 in 75. Percentage of Total Materials.			
	Retained.				Retained.				Retained.			
	In Closet Trap.	In Drain.	In Disconnecting Trap.	Cleared.	In Closet Trap.	In Drain.	In Disconnecting Trap.	Cleared.	In Closet Trap.	In Drain.	In Disconnecting Trap.	Cleared.
2 Gallons.	5	11	43	41	5	27	37	31	5	26	52	17
2½ "	2	2	27	69	2	9	38	51	2	8	64	26
3 "	1	0	23	76	1	1	25	73	1	3	46	50

TABLE B.—*Showing Result of* 240 *Experiments with* 6-*inch Drain Pipes and Channels. Drain* 50 *ft. long.*

Amount of Flush Water.	Gradient of Drain, 1 in 30. Percentage of Total Material.				Gradient of Drain, 1 in 40. Percentage of Total Material.			
	Retained.				Retained.			
	In Closet Trap.	In Drain.	In Disconnecting Trap.	Cleared.	In Closet Trap.	In Drain.	In Disconnecting Trap.	Cleared.
2 Gallons	5	9	33	53	5	14	35	46
2½ "	2	1	20	77	2	4	25	69
3 "	1	0	20	79	1	4	27	68

TABLE C.—*Showing Result of* 120 *Experiments with* 4-*inch Drain Pipes and Channels. Drain* 26 *ft. long.*

Amount of Flush Water.	Gradient of Drain, 1 in 40.			
	Percentage of Total Materials.			
	Retained.			Cleared.
	In Closet Trap.	In Drain.	In Disconnecting Trap.	
2 Gallons........	5	1	24	70
$2\frac{1}{2}$,, ...	2	0	24	74
3 ,, ...	1	0	16	83

TABLE D.—*Showing Result of* 120 *Experiments with* 6-*inch Drain Pipes and Channels. Drain* 26 *ft. long.*

Amount of Flush Water.	Gradient of Drain, 1 in 40.			
	Percentage of Total Materials.			
	Retained.			Cleared.
	In Closet. Trap.	In Drain.	In Disconnecting Trap.	
2 Gallons........	5	4	28	63
$2\frac{1}{2}$,, ...	2	1	27	70
3 ,, ...	1	1	21	77

EXPLANATORY NOTE.

The desirability of altering the Regulations made under the Metropolis Water Act, 1871, so as to allow a larger quantity than two gallons of water to be used for flushing water-closets, was brought before the Local Government Board by several Metropolitan Sanitary Authorities, from Nov. 1892 to May 1893, and the matter was referred by the Local Government Board to the London County Council. The County Council applied to The Sanitary Institute for an opinion upon the question before replying to the Local Government Board, and as the proposition was of considerable sanitary importance, the Council of the Institute thought it desirable to carry out some special experiments on the subject and record the results for the general information of those interested in the question. The report containing these records is given in the preceding pages, and a copy was forwarded to the London County Council. After receiving this report and making some further enquiries, the County Council in December last sent in an expression of opinion to the Local Government Board that the Regulations made under the Metropolis Water Act, 1871, should be altered, and that every water-closet flush cistern should be so constructed as to be capable of discharging three gallons of water at each flush. This recommendation was referred back to the County Council by the Local Government Board as not being within the purport of the Regulations referred to, which have for their object the prevention of waste, misuse or contamination of water. The County Council have therefore slightly modified the wording, and have agreed on the recommendation of their Public Health Committee, to make application to the Water Companies to amend the Regulations in the direction required.

THE SANITARY INSTITUTE.

FOUNDED 1876. INCORPORATED 1888.

PARKES MUSEUM, 74a, MARGARET STREET, LONDON, W.

EXAMINATIONS IN SANITARY KNOWLEDGE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

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THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances, in connection with the various Acts relating to Public Health, Drainage and Water Supply, the Sale of Food and Drugs, &c., led The Sanitary Institute of Great Britain in 1877 to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency in Sanitary knowledge.

The Sanitary Institute, in which the older body was incorporated in 1888, is continuing this important work.

The Examinations are arranged in two grades, and are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their competency on the subject of Examination. Many Boards and Corporations require Candidates, when making applications for appointments, to produce a certificate of this kind. A register of successful Candidates is kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application.

The Local Government Board have approved of The Sanitary Institute as a body, whose certificate, that a person has by Examination shown himself competent for the office of Sanitary Inspector, under the Public Health (London) Act, 1891, shall be sufficient for the purposes of the requirements in Section 108(2) (*d*) of that Act.

Up to December 31st, 1893, 89 Examinations had been held—33 for Local Surveyors, and 56 for Inspectors of Nuisances. 2579 Candidates had been examined, 244 as Local Surveyors, and 2335 as Inspectors of Nuisances; of these 1498 passed the Examinations and received Certificates, 118 as Local Surveyors, and 1380 as Inspectors.

In order to make the Examinations for Inspectors more accessible to

persons residing in the country, the Council now hold periodical Examinations in various centres, in addition to the Examinations held in London, provided that at least 20 Candidates send in applications for Examination. These Examinations are carried out in the same way as the Examinations in London, and no distinction is made in the Certificates granted.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies six hours—viz., usually from 11 a.m. till 2 p.m., and from 3 till 6 p.m., and consists of written papers only. Inspectors of Nuisances have three hours' written Examination on the first day. On the second day the Examination for each class is *vivâ voce*, with one or more questions to be answered in writing, if deemed necessary.

REGULATIONS.

Every Candidate is required to furnish the Board of Examiners with satisfactory testimonials as to age and personal character, and to give two weeks' notice previous to presenting himself for Examination. He must be able to write legibly and spell correctly, and possess a fair knowledge of arithmetic, so that he may be able to prepare a report on any subject connected with his duties, creditable to himself and to the Authority employing him.

No one under 21 years of age is admitted to the Examinations.

The fees payable for the Examination are as follows :—

As Surveyors, £5. 5s. As Inspectors of Nuisances, £3. 3s.

But when the Examinations are held in Provincial Towns in or out of England, £1. 1s. extra will be charged to the Candidate in order to cover the expenses incurred in holding an Examination out of London. The fee for Examination must be paid to the Secretary; 10s. 6d. on making application, and the remainder at least one week before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

A Certificate of Competency, signed by the Examiners, and bearing the Seal of the Institute, is granted to each successful Candidate.

Unsuccessful Candidates for the Inspectors' Examination are allowed to present themselves at any other Examination within twelve months on payment of half fees.

Any person having passed the Examination and received the Certificate for Local Surveyor is, by virtue of having such Certificate, upon proposal and election as Member of the Institute, exempt from payment of the Entrance Fee, and will be called upon to pay only the reduced subscription of £1. 1s. annually.

Any person having passed the Examination and received the Certificate for Inspector of Nuisances is, by virtue of having such Certificate, upon proposal and election as Associate of the Institute, exempt from payment of the Entrance Fee, and will be called only to upon pay the reduced subscription of 10s. 6d. annually.

The dates proposed for the Examinations for 1894 are as follows :—

For Surveyors—

London—Friday and Saturday, June 1st and 2nd.*

For Inspectors of Nuisances—

Nottingham	—Friday and	Saturday,	March 16th and 17th.
London	,,	,,	April 6th and 7th.
Durham	,,	,,	April 27th and 28th.
Bristol	,,	,,	May 4th & 5th.
Hull	,,	,,	May 25th and 26th.
Plymouth	,,	,,	June 22nd and 23rd.
Norwich	,,	,,	July 6th and 7th.
London	,,	,,	December 7th and 8th.
Cardiff	,,	,,	December 14th and 15th.
Liverpool	,,	,,	December 21st and 22nd.

The forms to be filled up before the Examination, by Candidates and by those persons recommending them, will be supplied on application to the Secretary.

* The Examination for Local Surveyors will be discontinued after this date.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

(1.) Laws and Bye-Laws—A thorough knowledge of the Acts affecting Sanitary Authorities, so far as they relate to the duties of Local Surveyors; also, of the Model By-Laws issued by the Local Government Board.

(2.) Sewerage and Drainage—The Sanitary arrangements of houses, including internal drainage, the construction of water-closets, privies, and dry-closets, the removal and disposal of refuse; the Sanitary defects of Builder's and Plumber's work; the Sanitary principles of Sewerage and Drainage and their application in the preparation of schemes for, and in the construction of, Sewerage works; the flushing and ventilation of sewers, and the treatment and disposal of sewage.

(3.) Water Supply of Towns and Houses—The sources of water, methods of collecting, purification (filtration, softening, &c.), and distribution. The Sanitary principles of Water Supply, and their application in the preparation of schemes for, and in the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

(4.) Structural—Regulation of Cellar Dwellings and Lodging Houses, and of Baths and Wash-houses; General principles of Ventilation and their practical application; the amount of air and space necessary for men and cattle; the means of supplying air, and of ensuring its purity.

(5.) Highways and Streets—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

Candidates will be required to make free-hand sketches.

FOR INSPECTORS OF NUISANCES.

Duties of Inspectors of Nuisances as defined by the order of the Local Government Board, March, 1891.	Syllabus of Subjects for Examination.
(1.) He shall perform, either under the special directions of the Sanitary Authority, or so far as authorized by the Sanitary Authority, under the directions of the Medical Officer of Health, or in cases where no such directions are required, without such directions, all the duties specially imposed upon an Inspector of Nuisances by the Public Health Act, 1875, or by any other Statute or Statutes, or by the Orders of the Local Government Board, so far as the same apply to his office.	The Provisions of the Acts and Model By-Laws relating to the duties of Inspectors of Nuisances.
(2.) He shall attend all meetings of the Sanitary Authority when so required. (3.) He shall by inspection of the District, both systematically at certain periods, and at intervals as occasion may require, keep himself informed in respect of the nuisances existing therein that require abatement. (4.) On receiving notice of the existence of any nuisances within the District, or of the breach of any by-laws or regulations made by the Sanitary Authority for the suppression of nuisances, he shall, as early as practicable, visit the spot, and inquire into such alleged nuisance or breach of by-laws or regulations. (5.) He shall report to the Sanitary Authority any noxious, or offensive businesses, trades, or manufactories established within the District, and the breach or non-observance of any by-laws or regulations made in respect of the same.	A knowledge of what constitutes a Nuisance. Methods of Inspection, of Dwellings, Cellar Dwellings, Dairies, Milk-shops, Markets, Slaughter-houses, Cow-sheds, Canal Boats and Nuisances especially connected with Trades and Manufactories.
(6.) He shall report to the Sanitary Authority any damage done to any works of water supply, or other works belonging to them, and also any case of wilful or negligent waste of water supplied by them, or any fouling by gas, filth, or otherwise, of water used for domestic purposes.	The Physical Characteristics of good Drinking Water—the various ways in which it may be polluted, by Damage to Supply Works or in Houses, and the means of preventing pollution—Methods of Water Supply.
(7.) He shall from time to time, and forthwith upon complaint, visit and inspect the shops and places kept or used for the preparation or sale of butchers' meat, poultry, fish, fruit, vegetables, corn, bread,	

flour, milk, or any other article to which the provisions of the Public Health Act, 1875, in this behalf shall apply, and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, milk, or any other article as aforesaid, which may be therein; and in case any such article appear to him to be intended for the food of man, and to be unfit for such food, he shall cause the same to be seized, and take such other proceedings as may be necessary in order to have the same dealt with by a Justice: Provided, that in any case of doubt arising under this clause, he shall report the matter to the Medical Officer of Health, with the view of obtaining his advice thereon.

The Characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables).

(8.) He shall, when and as directed by the Sanitary Authority, procure and submit samples of food, drink, or drugs suspected to be adulterated, to be analysed by the analyst appointed under "The Sale of Food and Drugs Act, 1875," and upon receiving a certificate stating that the articles of food, drink, or drugs are adulterated, cause a complaint to be made, and take the other proceedings prescribed by that Act.

The sale of Food and Drugs' Act.

(9.) He shall give immediate notice to the Medical Officer of Health of the occurrence within the district of any contagious, infectious, or epidemic disease; and whenever it appears to him that the intervention of such officer is necessary in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall forthwith inform the Medical Officer of Health thereof.

The Regulations affecting persons suffering or recovering from Infectious diseases, and some knowledge of such diseases—The principles of Ventilation, and simple methods of Ventilating Rooms—Measurement of Cubic Space.

(10.) He shall, subject to the directions of the Sanitary Authority, attend to the instructions of the Medical Officer of Health with respect to any measures which can be lawfully taken by an Inspector of Nuisances under the Public Health Act, 1875, or under any other Statute or Statutes, for preventing the spread of any contagious, infectious, or epidemic disease of a dangerous character.

Disinfectants and Methods of Disinfection.

(11.) He shall enter from day to day, in a book to be provided by the Sanitary Authority, particulars of his inspections and of the action taken by him in the execution of his duties. He shall also keep a book or books, to be provided by the Sanitary Authority, so arranged as to form, as far as possible, a continuous record of the sanitary condition of each of the premises in respect of which any action has been taken under the Public Health Act, 1875, or under any other Statute or Statutes, and shall keep any other systematic records that the Sanitary Authority may require.

(12.) He shall at all reasonable times, when applied to by the Medical Officer of Health, produce to him his books, or any of them, and render to him such information as he may be able to furnish with respect to any matter to which the duties of Inspector of Nuisances relate.

A Knowledge of the General Duties of the Office, and Methods of keeping the necessary Books and Records. Writing and Spelling.

(13.) He shall, if directed by the Sanitary Authority to do so, superintend and see to the due execution of all works which may be undertaken under their direction for the suppression or removal of nuisances within the district.

The proper conditions of good Drainage—The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builder's and Plumber's work—Scavenging and the Disposal of Refuse.

(14.) He shall, if directed by the Sanitary Authority to do so, act as Officer of the said Authority as Local Authority under the Contagious Diseases (Animals) Act, 1886, and any Orders or Regulations made thereunder.

(15.) In matters not specially provided for in this Order, he shall observe and execute all the lawful orders and directions of the Sanitary Authority, and the Orders of the Local Government Board which may be hereafter issued, applicable to his office.

Particulars as to Local Boards requiring Candidates to hold Certificates.

For several years past it has been the practice of many Local Authorities to insert in their advertisements for Inspectors of Nuisances clauses similar to the following, or otherwise to definitely recognise the desirability of a Certificate:–

Extract from advertisements—

POPLAR DISTRICT.

" . . . Candidates must possess a knowledge of building construction, and if not already in possession of the Certificate of The Sanitary Institute, must obtain such Certificate within twelve months of appointment. . . . "

PADDINGTON PARISH.

" . . . Applicants must have passed a satisfactory examination and be in possession of Certificates from The Sanitary Institute. . . ."

LIVERPOOL.

" . . . Candidates must hold the Certificate of The Sanitary Institute of Great Britain. . . ."

METROPOLITAN—(30).

City of London, 1891.
Battersea, 1885–9--91–3.
Bermondsey, 1893.
Bethnal Green, 1889-90-93.
Camberwell, 1891—92.
Chelsea, 1893.
Fulham, 1890—90.
Greenwich, 1890—91—92.
Hackney, 1891—93.
Hammersmith, 1891-2-3.
Hampstead, 1891—92.
Kensington, 1891-92-93.
Lambeth, 1890.
Limehouse, 1890.
Marylebone, 1891.
Newington, 1891—93.
Paddington, 1884—89.
Poplar, 1890—93.
Rotherhithe, 1893.
St. George's, Hanover Square, 1891.
St. George's-in-the-East, 1892.
St. James's, Westminster, 1891.
St. Luke's, 1887—91—93.
St. Margaret, Westminster, 1892—93.
St. Mary, Islington—1892—93.
St. Olave's, 1889.
St. Pancras, 1885—87—90—92.
St. Saviour's, 1889.
Wandsworth (4), 1888—89—91—92—93.
Whitechapel, 1891.

PROVINCIAL—(102).

Aberavon, 1893.
Alton, 1893.
Bangor, 1893.
Barnet, 1890.
Bath, 1890.
Battle, 1890.
Bedwellty, 1891—92.
Bexhill, 1892.
Bexley, 1893.
Birkenhead, 1891.
Birmingham, 1892.
Blackburn, 1892.
Blackpool, 1889.
Blean, 1890.
Bolton, 1893.
Bootle, 1893.
Bournemouth, 1891—92.
Bradfield, 1891.
Brierley Hill, 1890—91.
Bristol, 1884—86.
Bromley, Kent, 1891—91.
Cardiff, 1890—91—93.
Carlisle, 1890—93.
Carnarvon, 1891.
Chester-le-Street, 1893.
Chesterfield, 1892.
Chiswick, 1891.
Clay Lane, 1892.
Cleethorpes, 1893.
Coventry, 1891.
Croydon, 1891.
Darwen, 1891.
Dewsbury, 1886—90.
Dorchester, 1892.
Eastbourne, 1889.
Ely, 1888.
Exeter, 1889.
Festiniog, 1893.
Foleshill, 1891.
Grimsby, 1893.
Hailsham, 1886—91.
Halifax, 1892.
Hanley, 1891—92.
Hartlepool, 1890.
Hastings, 1892.
Hebburn, 1892.
Idle, 1892.
Kingston - upon - Hull, 1884—90—90.
Leeds, 1889.
Liverpool, 1886—91.
Lytham, 1887—92.
Maidstone, 1889—89.
Manchester, 1890-91-92-93
Margate, 1888—90.
Margam, 1893.
Midhurst, 1892.
Milton-by-Sittingbourne, 1887.
Nantyglo, 1891.
Nelson, 1892.
Newcastle-on-Tyne, 1891.
Newmarket, 1887—88—90—92—93.
Northampton, 1892.
Norwich, 1892—93.
Oswestry, 1887.
Plymouth, 1892.
Pontypool, 1892.
Pontypridd, 1890—92.
Poole, 1893.
Portsmouth, 1890.
Pottersbury, 1893.
Rhyl, 1890.
Risbridge, 1893.
Salford, 1891—92.
Scarborough, 1888.
Settle, 1893.
Sheffield, 1890—91—93.
Southampton, 1890—91.
Staffordshire County Council, 1892.
Stockport, 1891—92.
Stockton, 1887-90-91.
Stretford, 1892.

[*Continued on next page.*

LOCAL BOARDS REQUIRING CERTIFICATES—*Continued.*

Stroud, 1892—93.
Sunderland, 1885—92.
Swansea, 1893.
Tendring, 1891.
Thakeham, 1890—90—92.
Tonbridge, 1893.
Tunbridge Wells, 1893.
Twickenham, 1887.
Wakefield, 1891—93.
Ware, 1891.
Watford, 1887—93.
West Bromwich, 1892.
West Ham, 1891—93.
Wigan, 1891.
Willesden, 1891.
Winslow, 1893.
Wimbledon, 1890.
Winslow, 1893.
Wood Green, 1892.
Worthing, 1890—91—93.
Yorkshire, W.R., 1891.

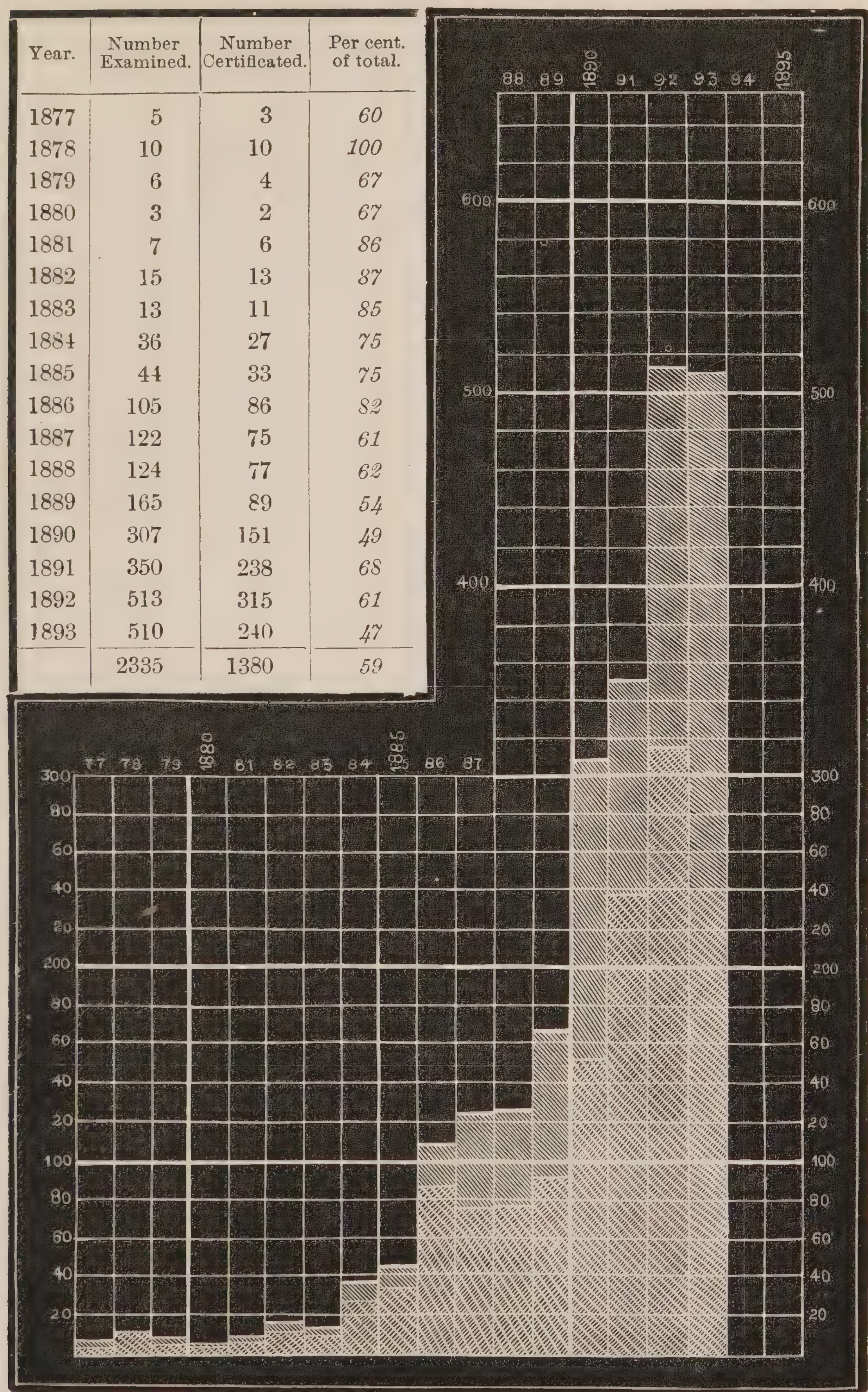
COLONIAL—(1).—Cape Colony, 1891.

Table shewing the number of Candidates examined & certified each year.

Year.	Number Examined.			Certificated.				
				Number.			Per cent. of Total.	
	Surveyor	Inspector	Total.	Surveyor	Inspector	Total.	Surveyor.	Inspector.
1877	3	5	8	2	3	5	*67*	*60*
1878	11	10	21	3	10	13	*27*	*100*
1879	4	6	10	2	4	6	*50*	*67*
1880	10	3	13	6	2	8	*60*	*67*
1881	7	7	14	2	6	8	*29*	*86*
1882	6	15	21	3	13	16	*50*	*87*
1883	7	13	20	3	11	14	*43*	*85*
1884	14	36	50	7	27	34	*50*	*75*
1885	20	44	64	5	33	38	*25*	*75*
1886	19	105	124	9	86	95	*47*	*82*
1887	17	122	139	7	75	82	*41*	*61*
1888	25	124	149	8	77	85	*32*	*62*
1889	9	165	174	5	89	94	*56*	*54*
1890	18	307	325	8	151	159	*44*	*49*
1891	11	350	361	8	238	246	*73*	*68*
1892	35	513	548	20	315	335	*57*	*61*
1893	28	510	538	20	240	260	*71*	*47*
	244	2335	2579	118	1380	1498	*48*	*59*

Table and Diagram shewing the number of Candidates examined and certified each year. Relating to Inspectors' Examination only.

Year.	Number Examined.	Number Certificated.	Per cent. of total.
1877	5	3	*60*
1878	10	10	*100*
1879	6	4	*67*
1880	3	2	*67*
1881	7	6	*86*
1882	15	13	*87*
1883	13	11	*85*
1884	36	27	*75*
1885	44	33	*75*
1886	105	86	*82*
1887	122	75	*61*
1888	124	77	*62*
1889	165	89	*54*
1890	307	151	*49*
1891	350	238	*68*
1892	513	315	*61*
1893	510	240	*47*
	2335	1380	*59*



NOTE.—The total number of Candidates is shewn by the whole height of the column shaded, and the number who have obtained Certificates by the lighter portion.

List of Towns where Congresses have been held.

Leamington, 1877.	Leicester, 1885.
Stafford, 1878.	York, 1886.
Croydon, 1879.	Bolton, 1887.
Exeter, 1880.	Worcester, 1889.
Newcastle-upon-Tyne, 1882.	Brighton, 1890.
Glasgow, 1883.	Portsmouth, 1892.
Dublin, 1884.	
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List of Towns where Examinations have been held.

FOR LOCAL SURVEYORS.

30	London, 1877 to 1893.	1	Cardiff, 1892.
1	Derby, 1892.	1	Dublin, 1893.
		33	

FOR SANITARY INSPECTORS.

34	London, 1887 to 1893.	1	Wakefield, 1892.
3	Manchester, 1889, 1891, 1893.	2	Cardiff, 1892, 1893.
2	Bristol, 1890, 1892.	1	Norwich, 1892.
2	Leeds, 1890, 1893.	1	Liverpool, 1892.
1	Birmingham, 1891.	1	Worcester, 1893.
3	Newcastle-upon-Tyne, 1891, 1892, 1893.	1	Lynn, 1893.
1	Stafford, 1891.	1	Exeter, 1893.
1	Derby, 1892.	1	Dublin, 1893.
		56	

List of Towns where Courses of Lectures to Sanitary Officers have been given.

16	London, 1885 to 1892.	1	Worcester, 1892.
1	Stafford, 1891.	1	Lynn, 1893.
1	Derby, 1892.	1	Exeter, 1993.
1	Wakefield, 1802.	1	Dublin, 1893.
1	Cardiff, 1892.	1	Keighley, 1893.
1	Newcastle-upon-Tyne, 1892.	1	Huddersfield, 1893.
1	Norwich, 1892.	1	Nottingham, 1894.
1	Liverpool, 1892.		
		30	

Map showing the various Centres to which the work of the Institute has been extended.

LIST OF CANDIDATES WHO RECEIVED CERTIFICATES DURING 1893.

LOCAL SURVEYORS.

1893, June 10. ADAMS, ALBERT EDWARD, Town Hall, Grimsby.
1893, Nov. 30. ADAMS, HENRY C., 60, Queen Victoria Street, E.C.
1893, Nov. 30. BALL, CHARLES F., 51, Prince Street, Bristol.
1893, Juue 10. BASSETT, GILBERT THOMAS, Highfield Road, Saltley, Birmingham.
1893, June 10. BUSBRIDGE, HAROLD, 96, Herbert Road, Plumstead.
1893, June 10. ELFORD, ERNEST JOHN, City Engineer's Office, Norwich.
1893, June 10. HADDOCK, HARRY FREDERICK, 9, Eland Road, Lavender Hill, S.W.
1893, Nov. 30. HILL, WILLIAM HENRY, Jun., Audley House, Cork.
1893, June 10. HOGBIN, LEONARD WILLIAM, Surveyor, Minster, Ramsgate.
1893, Nov. 30. KILLICK, WILLIAM HENRY, Borough Surveyor's Office, Southampton.
1893, June 10. LAMBERT, JOSHUA, Local Board Offices, Tottenham.
1893, Nov. 30. LEE, LENNIE HENRY, Supervisor, Public Works Department, Calcutta, India.
1893, Nov. 30. PERKINS, THOMAS L., 1, West Shrubbery, Redland, Bristol.
1893, June 10. PHELPS, WILLIAM, 32, St. Stephen's Avenue, Shepherd's Bush.
1893, June 10. SCOTT, THOMAS KEAT, Town Surveyor, Whitby.
1893, Nov. 30. SEWARD, WILLIAM B., 120, Camberwell Road, S.E.
1893, June 10. SPINK, JOSEPH, Formby, Liverpool.
1893, June 24. TIGHE, MICHAEL J., 8, Upper Sherrard Street, Dublin.
1893, Nov. 30. WILLIS, EDWARD, 124, High Street, Eton.
1893, June 10. WORRALL, ERNEST, 5, Beaconsfield Terrace, Seacombe, Liverpool.

INSPECTORS OF NUISANCES.

1893, Apr. 15. ALLAN, GEORGE AWBURN, Junr., 5, Clipstone Street, Gt. Portland Street, W.
1893, Jan. 28. ANDREW, GEORGE WALTER, 211, Monument Road, Birmingham.
1893, Dec. 2. ANTHONY, THOMAS, 10, Hormead Road, Paddington.
1893, Apr. 15. ARMSTRONG JOSEPH, 3, Colveston Crescent, Kingsland.

1893, Dec. 2. Asher, Harry, Albert Metal Works, Tiverton, Bath.
1893, Jan. 28. Ashfield, Ralph, 5, Lansdowne Street, Worcester.
1893, Nov. 11. Aubin, Percy A., 29, St. James's Street, St. Helier's, Jersey.
1893, Apr. 15. Axtell, Alfred, 1, Gloucester Road, S.W.
1893, Dec. 2. Balfour, Alexander, 17a, High Road, Kiburn.
1893, Apr. 15. Ball, Alfred John, 25, Oriental Street, East India Dock Road, Poplar, E.
1893, Apr. 15. Barker, Frederick, 5, Lawrence Street, Stockton-on-Tees.
1893, Dec. 2. Barker, George Forster, 68, Hillier Road, Wandsworth Common.
1893, Dec. 2. Barker, Herbert, 43, Meeson Rd., West Ham, E.
1893, Apr. 15. Barralet, Thos. Chapman, Surveyor and Inspector, Godstone Rural Sanitary Authority.
1893, Apr. 15. Barrett, Henry James, 20, Gowan Avenue, Fulham.
1893, Dec. 2. Barton, James Henry, 14, Young's Road, Folkestone.
1893, July 8. Bedford, Edward, Chapel Allerton, Leeds.
1893, Apr. 15. Bennett, Edward, 43, Manor Park Road, Harlesden.
1893, Dec. 2. Blackburn, Thomas, Borough Engineer's Department, Brighton.
1893, Apr. 15. Blay, Ernest Berringer, 116, Matthias Road, Stoke Newington, N.
1893, Dec. 2. Blowfield, Ernest Frederick, 3, Camberwell Station Road, S.E.
1893, Dec. 2. Boden, Walter John, 133, Finchley Road, N.W.
1893, Apr. 29. Bone, William Homersham, 35, Mall Road, Hammersmith.
1893, Apr. 15. Bridel, Harry Frederick, 3, Ballast Quay, East Greenwich, S.E.
1893, Apr. 15. Bridges, Oswald Arthur, 14, Park Road, Ryde, Isle of Wight.
1893, July 8. Brierley, Samuel, 26, Elford Grove, Roundhay Road, Leeds.
1893, Dec. 16. Brooke, John, Town Surveyor and Inspector, Northwich.
1893, Jan. 28. Brown, Walter, 148, Green Lane, Small Heath, Birmingham.
1893, Apr. 15. Brown, William, 36, Clyde Road, Brighton.
1893, Dec. 16. Bryan, Eli, 32, Annerley Street, Edge Hill, Liverpool.
1893, Dec. 2. Budden, Alexander, Junr., Mission House, Larch Road, Balham.
1893, July 29. Bullock, James, Sanitary Inspector, Scarborough.
1893, Dec. 2. Burrington, Thomas, Madge, Prospect, Swindon.
1893, Apr. 15. Burrough, Arthur John, 47, Shaftesbury Road, Gosport.
1893, Apr. 15. Campbell, Colin, 10, Edith Road, West Kensington.

1893, Apr. 15. CASS, THOMAS F., 6, Lansdowne Street, Hull.
1893, Dec. 2. CATTERALL, JAMES LAMB. 270, Vauxhall Bridge Road, Pimlico.
1893, July 29. CAWSEY, THOMAS, 12, Coedpenmaen Road, Pontypridd.
1893, May 27. CHALLICE, GEORGE MARKS, 141, Sidwell Street, Exeter.
1893, Apr. 29. CHESTERFIELD, HENRY JAMES, 1, Balfour Street, Hull.
1893, July 29. CHOULER, R. B., 1, Calthorpe Street, Gray's Inn Road, W.C.
1893, Jan. 28. CODLING, HENRY, West Boldon, Co. Durham.
1893, Dec. 2. COLLETT, H. HERBERT, 77, Myrdle Street, Commercial Road, E.
1893, Dec. 2. COLLINS, ARTHUR WALTER, 172, High St., Peckham.
1893, Dec. 2. COLLINS, EDWIN RICHARD, 4, Pembroke Villas, Underhill Road, East Dulwich.
1893, Jan. 28. CONWAY, ISAAC HENRY BUGLER, Lillinton, Sherborne, Dorset.
1893, Dec. 2. COOK, JOSEPH, 20, Gowan Avenue, Fulham.
1893, Dec. 16. COOK, WILLIAM, 7, Duddon Road, Askam-in-Furness.
1893, Apr. 15. COOKE, CHARLES, 152, St. Thomas Road, Finsbury Park, N.
1893, Apr. 15. COTTRELL, JOHN, Fallowfield, Manchester.
1893, July 29. COWLING, JOHN COOMBE, Penpont, Altarnun, Launceston.
1893, Dec. 2. CRATHORN, JOSEPH, Gordon Street, Garrison Lane, Birmingham.
1893, Apr. 15. CRUTTENDEN, THOMAS FRANK, 9, Tower Road, W., St. Leonards-on-Sea.
1893, Dec. 2. CURD, ALBERT E., 24, David's Rd., Forest Hill, S.E.
1893, Apr. 15. DALRYMPLE, ALEXANDER, 17, Wellington Street, Ayr, N.B.
1893, Dec. 16. DAVIES, ALBERT JOHN, 158, Severn Road, Cardiff.
1893, July 8. DAVIES, ANNIE M., The Gymnasium, Waterloo, Liverpool.
1893, July 8. DAVIES, THOMAS, 79, Walthall Street, Crewe.
1893, Apr. 15. DAVIS, JOHN EDWARD, 309, King's Road, Chelsea, S.W.
1893, Dec. 2. DEANE, LUCY ANNE EVELYN, 100, Fulham Road, S.W.
1893, May 27. DILKE, FRANCIS HENRY, 24, City Road, Bristol.
1893, Dec. 2. DUNBAR, MARGARET, 41, Great Coram Street, W.C.
1893, Jan. 23. DUNLOP, ANDREW, Park Farm, Witley, Stourport.
1893, Dec. 2. DUNN, CHARLOTTE ELIZABETH, Kelfield Lodge, York.
1893, Apr. 15. DUNN, JAMES STEPHEN, Board of Words, Poplar, E.
1893, Dec. 2. EATON, HARRINGTON HOLLOWAY, 64, The Green, Darlaston.
1893, Dec. 2. ELLETSON, JOHN MALAM, 131, Tachbrook St., S.W.
1893, Apr. 29. ELLIS, WILLIAM BAXTER, 31, Manbey Grove, Stratford, E.

1893, Nov. 11. Ellwood, William, Brigham, Cockermouth.
1893, Apr. 15. Evans, Percival Baker, 16, Irene Road, Poole Park, Fulham.
1893, July 29. Evans, Samuel, 36, Ryder Street, Canton, Cardiff.
1893, Apr. 15. Few, Herbert Arthur, 19, Highbury Park, N.
1893, Dec. 2. Fillis, Edgar, 3, Chester Terrace, Brighton.
1893, July 8. Findlay, Alexander Burns, 97, Canning Street, Bridgeton, Glasgow.
1893, Jan. 28. Fletcher, Walter John, F.R.I.B.A., Wimborne, Dorset.
1893, Dec. 16. Fowles, Joseph Henry, 13 & 15, Hornby Street, Heywood, Lancashire.
1893, Jan. 28. Franks, Edwin James (deceased).
1893, Jan. 28. Furber, Frank Arthur, 139, Ladywood Road, Birmingham.
1893, Apr. 15. Gentry, Herbert John, 63, Loftus Road, Shepherd's Bush, W.
1893, May 27. Gibbard, John Richard, 5, Old Tiverton Road, Exeter.
1893, July 29. Glover, Frank, 8, Spring Gardens Terrace, Roath, Cardiff.
1893, Jan. 28. Godfrey, Bernard, Droitwich.
1893, Dec. 2. Gooderham, Francis Frederick, Town Hall, Great Yarmouth.
1893, Dec. 16. Graham, James, 53, Sarah Ellen Street, Blackburn.
1893, May 27. Gray, Arthur Herbert, Ordnance Store Corps, Woolwich.
1893, Apr. 15. Gregory, Edward George, 11, Briscoe Rd., Merton.
1893, Apr. 15. Gregory, Frank.
1893, Dec. 2. Hall, James William Wharton, 34, St. Julien's Road, Kilburn.
1893, Dec. 2. Hamlin, Hourston, 203, Burrage Road, Plumstead.
1893, Apr. 15. Hannant, William B., 34, Blenheim Terrace, St. John's Wood, N.W.
1893, July 8. Hardman, John, 14, St. George's Road, Preston.
1893, July 8. Hargreaves, John Emanuel, 53, Berry Street, Burnley.
1893, Jan. 28. Harrison, Edward Stanhope, Sanitary Inspector, Swansea.
1893, July 8. Harrison, John Benson, 110, King Street, Southport.
1893, Dec. 2. Hattersley, Jesse Earland, 1, Basuto Road, Poole Park, Fulham.
1893, Apr. 29. Haynes, Josiah Ernest, Watton, Norfolk.
1893, Apr. 15. Head, Arthur Parr, 39, Barnsdale Road, St. Peter's Park, W.
1893, Dec. 2. Henley, Sidney H., 22, Grosvenor Rd., Richmond Surrey.
1893, Apr. 15. Hewitt, Francis Joseph, 9, Bridge Road, Edgehill, Liverpool.

1893, Apr. 15. Hibbert, Thomas, New Road, Ware, Herts.
1893, Dec. 16. Higginson, Frank, 10, Birmingham Street, Bolton.
1893, July 8. Hogg, Arthur, 35, Dale Street, Huddersfield.
1893, July 29. Holbourn, Stephen J., 31, George Street, Docks, Cardiff.
1893, Dec. 2. Holbrook, John William, 9, Freemantle Place, Stokes Croft, Bristol.
1893, July 29. Holden, John White, 91, Strathnairn Street, Roath, Cardiff.
1893, Dec. 2. Holmes-Walker, Frederick, 13, Sheen Dale Villas, Richmond, Surrey.
1893, Apr. 15. Hooper, Thomas Henry, 61, Wandsworth Road, S.W.
1893, Dec. 16. Horsfield, Jonathan P., Salford Union Infirmary, Eccles.
1893, Dec. 2. Howes, Ernest, 19, Flint Street, Walworth, S.E.
1893, July 8. Hutton, Albert Edward, 38, Swamp, Queensbury.
1893, Dec. 16. Hutton, John, 22, Highgate, Kendal.
1893, Jan. 28. Jackson, Thomas, 288, New Hall Road, Preston.
1893, Dec. 2. Jackson, Thomas Henry, 1, Badsworth Road, Camberwell.
1893, May 27. Jarvis, Edward James, 78, Treville Street, Plymouth.
1893, July 29. Jenkins, David, Port Sanitary Offices, Docks, Cardiff.
1893, Apr. 15. Joels, William George.
1893, Apr. 15. Johns, David James, 28, Gelli Road, Tonpentre, South Wales.
1893, Dec. 2. Johnson, George Edward, 1, Kingsley Road, Willesden Lane, Kilburn.
1893, July 29. Jones, Thomas, Tŷ Ivor, Melincrythan, Neath.
1893, Apr. 15. Jones, William Robert, 49, Bowsfield Road, St. Catherine's Park, Hatcham.
1893, Dec. 2. Jordan, Edward T. D., 13b, Gardnor Road, Hampstead.
1893, Jan. 28. Keasey, Henry, 41, Stirling Road, Edgbaston.
1893, July 8. Kendall, Alan, 46, Sefton Street, Southport.
1893, May 27. Kerslake, Richard P. C., 71, Sidwell Street, Exeter.
1893, Apr. 15. King, Claude, 24, Prince of Wales Road, Norwich.
1893, July 8. Kirk, William Willey, 40, Bateman Street, Hyson Green, Nottingham.
1893, Dec. 2. Knappett, Benjamin Albert, East View New Road, Weybridge.
1893, Apr. 15. Ladd, Henry Frederick Burnham, 5, Crompton Terrace, Walmer.
1893, Apr. 15. Lamble, Philip Thomas, 14, Chichester Street, Paddington.
1893, Jan. 28. Lane, Fountain Edward, Holly Cottage, Upton-on-Severn.

1893, Jan. 28. LATHAM, ASHTON, 12, Cable Street, Southport.
1893, July 8. LATIMER, GEORGE COLLIN, 56, Salop Street, Kirkdale, Liverpool.
1893, Jan. 28. LAWSON, ARCHIBALD, 103, Leinster Road, Rathmines, Dublin.
1893, June 24. LAWSON, ROBERT, The Grove, Northbrook Road, Dublin.
1893, Apr. 15. LENEY, ALFRED EDWIN, Fothersby House, Hawkhurst, Kent.
1893, Apr. 15. LEWIS, JAMES, 17, Heyford Avenue, South Lambeth Road, S.W.
1893, Apr. 15. LEWIS, JOHN, 22, Tower Road, Boscombe, Bournemouth.
1893, Dec. 2. LILL, GEORGE DAVEY, 167, Brunswick Road, Poplar, E.
1893, Dec. 2. LILLIE, EDWARD JOHN, 97, St. John's Wood Terrace, N.W.
1893, Dec. 16. LIVESEY, HENRY, Primrose Villa, Fulwood, Preston.
1893, Jan. 28. LLOYD, THOMAS, 16, New Street, Stourport.
1893, Apr. 15. LOCKWOOD, ARTHUR CHARLES, 49, Queen's Road, Crown Hill, Norwood.
1893, Apr. 15. MANNING, FREDERICK HENRY, 12, Cobden Road, Brighton.
1893, Dec. 16. MARKS, CHARLES WILLIAM, 27, Shaftesbury Street, Eccles.
1893, Dec. 2. MATCHETT, WILLIAM EDWARD, Aberdeen Villa, Heathfield Road, Bromley, Kent.
1893, Jan. 28. MATTHEWS, HENRY, Grimley, Worcester.
1893, Dec. 2. MAY, WILLIAM JOHN, 29, Sandringham Road, Dalston.
1893, Dec. 2. MILLARD, WILLIAM, 1, Holmes Place, Fulham Road, S.W.
1893, July 29. MILLS, ARTHUR EDWARD, 2, Market Street, Wells, Somerset.
1893, Dec. 2. MILTON, JOHN, 47, Mount Row, Berkeley Square, W.
1893, Apr. 15. MITCHENER, WILLIAM EDWARD, 27, New York Street, Brighton.
1893, Dec. 2. MOFFATT, SIDNEY PAGET, Holy Trinity Vicarage, Blackburn.
1893, Nov. 11. MOLE, JOHN HEDLEY, East Boldon, Newcastle-upon-Tyne.
1893, July 29. MOORE, CHARLES, Guildhall, Wrexham.
1893, July 29. MORGAN, EVAN THOMAS, 1, Llwynmadoc Street, Graigwen Road, Pontypridd.
1893, Apr. 15. MORGAN, FORBES, 62, Camden Street, Camden Town.
1893, Dec. 2. MUNCKTON, CHARLES, Wimborne Minster, Dorset.
1893, Nov. 11. MUSE, JOHN GILL, 27, North Hamilton Street, Kilmarnock.
1893, Apr. 15. OLLIS, JOHN JAMES, Hill Farm, Saltford, Bristol.

1893, Nov. 11. ORKNEY, WILLIAM CARNEGI, Moncrieffe, Perth.
1893, Apr. 15. OWEN, WILLIAM, Post Office, Glen Garth, Anglesea.
1893, Jan. 28. PACY, WILLIAM, Worcester.
1893, May 27. PALMER, ISAAC FAIRLEY, Ewell Road, Surbiton Hill.
1893, Apr. 15. PARKER, WILLIAM ROE, 25, Treville Street, Plymouth.
1893, Dec. 2. PARSLOW, CHARLES JAMES, 39, Linver Rd., Fulham.
1893, Apr. 15. PATERSON, ARTHUR WILLIAM, Station Road, New Barnet.
1893, Jan. 28. PEAKE, WILLIAM ALTREE, Assistant-Surveyor, Cannock, Staffordshire.
1893, May 27. PEARSE, RICHARD BLAKE, 30, Portland Street, Exeter.
1893, June 24. PEMBERTON, JOSEPH J., 23a, Charlemont Street, Dublin.
1893, May 27. PENGELLY, JOHN ISAAC, 15, St. James's Road, Exeter.
1893, Dec. 2. PERRIN, WILLIAM JAMES, 12, Collier Street, Pentonville.
1893, July 8. PEXTON, EDWARD, Shop Lane, Kirkheaton.
1893, Apr. 15. PIERCY, EDMUND ERNEST, 18, Fentiman Road, Clapham.
1893, Apr. 15. PIKE, WILLIAM HENRY, Ordnance Store Corps, Woolwich.
1893, Jan. 28. PITCHFORTH, SAMUEL ABRAHAM; 3, Chestnut Villa, Foleshill, Coventry.
1893, Dec. 2. PLESTED, HORACE THOMAS, 6, Emily Terrace, Putney.
1893, Dec. 2. PLUMER, WALTER, 14, Kennington Grove, S.E.
1893, Dec. 2. POWELL, WILLIAM GEORGE, 19, Kingsfield Road, Southampton.
1893, July 29. PRESTON, ALFRED PEARCE, 42, Arran Street, Cardiff.
1893, July 8. PRINCE, S. E., 37, Warwick Street, Rotherham.
1893, Dec. 2. PULFER, FREDERICK CHARLES, 16, Kitto Road, St. Catherine's Park, S.E.
1893, Dec. 2. PUZEY, FREDERICK, 187, Brighton Road, Croydon.
1893, May 27. QUICK, EDWARD HARE, Lympstone, Devon.
1893, Dec. 2. RABBETTS, CHARLES GEORGE, 55, Middle Street, The Avenue, Southampton.
1893, Apr. 15. RALPH, WILLIAM HOLDEN, 19, Howard Road, Brighton.
1893, Apr. 15. RANDS, HAROLD WALTER, Whitby's School, Chichester.
1893, Dec. 2. RAPSON, THOMAS HENRY, 28, Poynings Road, Upper Holloway, N.
1893, Apr. 29. RAYNER, GEORGE, The Green, Downham Market.
1893, Dec. 16. REID, WILLIAM JOHN, 99, Bradbury Place, Belfast.
1893, July 8. REYNOLDS, ERNEST FRESHFIELD, Guildford House, Harrogate.
1893, Apr. 15. RICHARDSON, FRED, High Street, Brasted, Sevenoaks.
1893. Dec. 2. RICKETT, GEORGE, Roxburgh House, Westgate-on-Sea.

1893, July 29. Riggs, John William, 3, Avenue Cottages, Torquay.
1893, Nov. 11. Robson, Charles, 3, Churton Road, North Shields.
1893, Dec. 2. Romeril, William George, 20, Burney Street, Greenwich, S.E.
1893, Apr. 29. Rouse, Frank J., Student Inst.C.E., 3, Manor Way, Blackheath.
1893, Nov. 11. Rugg, Hugh Daniel, 22, Woodstock Road, Poplar, London, E.
1893, Apr. 15. Rugg, Samuel Horace, 165, Earls Court Road, S.W.
1893, Dec. 2. Scarfe, Roland, 19, The Chase, Clapham Common.
1893, Apr. 15. Schlund, William Theodore, 46, Kemp Street, Brighton.
1893, Dec. 2. Sexton, Charles George, 3, Kildare Terrace, Hanworth Road, Hounslow.
1893, Apr. 15. Sharman, Edward Mansfield, 104, Acomb Street, Greenheys, Manchester.
1893, Dec. 2. Shervill, John Alfred, 1, Arthur Villas, Queen's Road, Teddington.
1893, Apr. 15. Simms Frederick, 29, Adelaide Street, St. Giles, Oxford.
1893, Jan. 28. Sinclair, George Alfred, 14, Mabel Terrace, Sunderland.
1893, July 29. Slade, Frank Robert, Princes Street, Bristol.
1893, Apr. 15. Smith, Edward, 418, New Cross Road, S.E.
1893, Apr. 15. Smith, Henry John, 91, Malvern Road, West Kilburn, N.W.
1893, Apr. 15. Smith, William, Preston, The Hyde, N.W.
1893, Apr. 15. Squirrell, Henry Thomas, 5, Station Road, Bexhill.
1893, Apr. 15. Strathon, William Henry, 3, Auburn Place, Plymouth.
1893, May 27. Streat, John, Ottery St. Mary, Devon.
1893, Dec. 2. Swinnock, William James, 218, Sultan Road, Landport, Portsmouth.
1893, July 8. Swire, Henry, 30, Sheep Street, Skipton.
1893, May 27. Sykes, Edith Elizabeth, Woodleigh, East Dulwich Grove, S.E.
1893, Nov. 11. Symon, George, 30, Mitford Street, Newcastle-upon-Tyne.
1893, July 8. Taylor, James, 267, Tong Moor Road, Tong, Bolton.
1893, Dec. 16. Terry, John, 24, Moorgate, Bury.
1893, Jan. 28. Thomas Charles Llewellin, 30, Berkeley Place, Clifton, Bristol.
1893, Nov. 11. Turnbull, Fred R., 24, York Street, West Hartlepool.
1893, Jan. 28. Turner, Frederic Richard, Plough Inn, Tewkesbury.

1893, Apr. 15.	VEST, THEODORE, 75, Queen's Park Road, Brighton.
1893, July 8.	WAGSTAFF, WILLIAM HENRY, 16, Mapperley Road, Nottingham.
1893, Jan. 28.	WALKER, WILLIAM, 50, Artillery Street, Birmingham.
1893, Dec. 2.	WALLIS, FRANCIS FREDERICK, 96, Archway Road, Highgate.
1893, Dec. 2.	WARD, ARTHUR, 14, Kemp Street, Brighton.
1893, Dec. 16.	WATERS, THOMAS, 12, Rylance Street, Ardwick, Manchester.
1893, July 8.	WATSON, JAMES SYKES, 17, Barclay Street, Sunderland.
1893, Dec. 2.	WAY, WILLIAM, 159, Hartfield Road, Wimbledon.
1893, Apr. 15.	WEBSTER, JOHN WILLIAM, 3, Lanhill Road, Paddington.
1893, Dec. 2.	WHEATLEY, HARRY JAMES, 3, Townshend Terrace, Sheen Road, Richmond, Surrey.
1893, July 8.	WHINCUP, WILLIAM THOMPSON, 7, East Parade, Heworth, York.
1893, Jan. 28.	WHITE, WILLIAM LAMB, New Street, Upton-on-Severn.
1893, Apr. 15.	WIGGS, HERBERT TREHERNE, 166, Railton Road, Herne Hill, S.E.
1893, Dec. 2.	WILLIS, EDWARD, 124, High Street, Eaton.
1893, Nov. 11.	WILSON, MARMADUKE TEMPLE, 69, Narrowgate, Alnwick.
1893, Dec. 2.	WINKWORTH, HARVEY, Goring Heath, Reading.
1893, Dec. 2.	WINKWORTH, JOHN, Goring Heath, Reading.
1893, Dec. 2.	WISE, SYDNEY EDWARD, 200, Burrage Road, Plumstead.
1893, May 27.	WRIGHT, SAMUEL WILLIAM, 17, Melville Road, Ford, Devonport.

EXHIBITIONS HELD IN CONNECTION WITH THE CONGRESSES OF THE INSTITUTE.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.	1883. Glasgow.	1884. Dublin.	1885. Leicester.	1886. York.	1887. Bolton.	1889. Worcester.	1890. Brighton.	1892. Portsmouth.
Number of Exhibitors	117	116	189	106	110	126	134	135	130	112	108	108	156
Number of Exhibits	294	319	710	500	600	750	900	1,000	900	800	800	1,000	2,000
Space occupied (in square ft.)	......	......	......	9,725	14,520	20,000	40,000	30,000	30,000	25,000	28,000	30,000	35,000
Number of days Exhibition was open	14	16	17	19	25	25	19	17	26	29	23	18	24
Total number of Visitors	......	......	......	8,955	8,373	20,000	35,000	37,000	30,000	27,000	23,000	35,000	49,000
Number of Medals awarded	13	13	12	12	15	21	18	34	16	14	30	31*	17*
Number of Special Certificates	None.	6	9	7	4	13	11	11	12	9	None.	None.	None.
Number of Certificates	None.	22	38	40	72	58	83	79	64	40	71	86*	66*
Number of Exhibits deferred for further trial	......	7	52	30	37	44	39	119	42	46	67	67	38

* These do not include all the awards which may be given for Exhibits selected for further practical trial.

CONTRIBUTIONS TO LIBRARY DURING 1893.

In addition to the works enumerated in the following list, valuable donations of books, pamphlets, and official publications have been received from Mrs. Chevers *(wife of the late* Dr. Norman Chevers*) and* Mr. W. Whitaker.

*** For publications of Societies and Institutions, &c., see under "Academies."

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——— Bye-Laws made by the Council, under Section 31 of the London Council (General Powers) Act, 1890. 2 p., f. cap. *The Conncil.*

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——— Bye-Laws for regulating the Conduct of Fat Melter and Fat Extractor. 3 p., f. cap. *The Council.*

——— Bye-Laws for regulating the Conduct of the Business of a Glue and Size Manufacturer. 3 p., f. cap. *The Council.*

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	Year.	
Birmingham	1892.	*Dr. Alfred Hill.*
Bolton	,,	*Dr. Adams.*
Calcutta	,,	*Dr. W. J. Simpson.*
Cambridge	,,	*Dr. B. Anningson.*
Cardiff	,,	*Dr. Walford.*
Chelmsford Rural Sanitary Authority	,,	*Dr. J. C. Thresh.*
Chesterton Local Board	,,	*Dr. B. Anningson.*
Cornwall County Council ..	,,	*S. Trevail.*
Cromer	,,	*S. T. Taylor.*
Dublin	,,	*Sir C. Cameron.*
Dumbarton County Council ..	1891, 1892.	*D. Dunbar.*
Ely Union, R.S.A.	1892.	*Dr. B. Anningson.*
Erpingham Union	,,	*S. T. Taylor.*
Hackney District Board of Works	,,	*Dr. King Warry.*
Hastings	,,	*Dr. A. S. Wilson.*
Lanark, County of	1891, 1892.	*A. Hay.*
Liverpool	1892.	*Dr. J. S. Taylor.*
Maldon Rural Sanitary Authority	,,	*Dr. J. C. Thresh.*
Merthyr Tydfil	,,	*T. J. Dyke.*
Middlesex and Hertfordshire Combined Sanitary Districts ..	1885—91.	*W. Gruggen.*
Newcastle-on-Tyne	1891.	*Dr. Armstrong.*
Nottingham	1892.	*Dr. Boobbyer.*
River Tyne Port Sanitary Authority	,,	*Dr. H. E. Armstrong.*
Royston Union, R S. A.	,,	*Dr. B. Anningson.*
St. Faith's Union	,,	*S. T. Taylor.*
St. George's, Hanover Square (Analyst)	,,	*C. E. Cassal.*
St. Ives Union, R.S.A.	,,	*Dr. B. Anningson.*
St. Mary Abbotts	,,	*Dr. Dudfield.*
,, ,, (Analyst) ..	,,	*C. E. Cassal.*
St. Mary, Battersea (Analyst) ..	,,	,,
St. Pancras	,,	*Dr. J. F. J. Sykes*
Southampton	,,	*Dr. A. W. Harris.*
Wandsworth	,,	*The Board.*
Watford	,,	*Dr. A. T. Brett.*
Whitechapel	,,	*Dr. J. Loane.*
Wigan	,,	*J. Sumner.*
Wolverhampton	1893.	*Dr. H. Malet.*

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——— Annual Reports for the years, 1884, 1888-89, 1889-90. *A. Hale.*

Smith, *J. Barker.* Milk, a new system of rapid analysis. 24 p., 8vo. London, 1892. *The Author.*

Stevenson, *Dr. T.*, and *Shirley Murphy.* Treatise on Hygiene and Public Health, Vol. II. 847 p., 8vo. London, 1893. *J. & A. Churchill.*

Street, *W. C.* Some problems of Town Development. 12 p. 4to. Excerpt "Journal Royal Institute of British Architects," Vol. IX., New series 19. *The Author.*

Sworder, *H.* Popular Information concerning Infectious Diseases. 82 p., 8vo. London, 1893. *Dr. Thorne Thorne.*

Taylor, *A.* The Sanitary Inspector's Handbook. 243 p., 8vo. London, 1893. *The Author.*

Thomas, *E. Lewis.* The Public Health (London) Act, 1891, with full explanatory notes. 393 p., 8vo. London, 1891. *Purchased.*

Thorne, *Dr. Thorne.* Cholera Prospects and Prevention. 31 p., 16mo. London, 1893. *The Author.*

United States Army. Index-Catalogue of the Surgeon-General's Office, Vol. XIII. 1005 p., 4to. Washington, 1892. *The Surgeon-General U. S. Army.*

Vacher, *Francis.* The Food Inspector's Handbook. 140 p., 8vo. London, 1893. *The Author.*

Ventilation. A paper read at the Royal United Service Institution December 7th, 1892. 54 p. Reprint from "Building News," December 22nd, January, 1893. *W. Whitaker.*

Wallace, *J.* Sanitary Engineering in India. 238 p., 8vo. Bombay, 1893. *The Author.*

Wardle, *T.* Sewage Treatment and Disposal. 426 p., 8vo. Manchester and London, 1893. *The Author.*

Waring, *Col. G. E., Jun.* The Memphis System of Sewage at Memphis and elsewhere. 18 p., 8vo. Concord N.H., 1893. Reprint from Vol. XVIII. of the Transactions of the American Public Health Association. *The Author.*

——— Report on the Condition of the Sewers of Memphis, March 4th, 1893. 10 p., 8vo. Memphis, 1893. *The Author.*

Willoughby, *Dr. E. T.* The Health Officer's Pocket Book. 376 p., 16mo. London, 1893. *The Author.*

Williams, *Robert.* London Rookeries and Colliers' Slums. A plea for more breathing room. 82 p., 4to. London, 1893. *The Author.*

Winwood, *H. H.* On some Deep Well Borings in Somerset and elsewhere. 10 p., 8vo. Excerpt proceedings of the Bath Natural History and Antiquarian Field Club, 1893. *W. Whitaker.*

PERIODICALS AND JOURNALS.

Weekly.

British Medical Journal.
Builder.
Contract Journal.
County Council Times.
Illustrated Carpenter and Builder.
Industries and Iron.
Invention.
Journal d'Hygiène.
Journal Society of Arts.
Local Government Chronicle.
Local Government Journal.
Nursing Record.
Surveyor.
The Sanitary Record.

Monthly.

Engineering Review.
Health Record, Dublin.
Hygiene.
Ironmonger.
Journal of the Royal Institute of British Architects.
Medical Magazine.
Meteorological Record.
Plumber and Decorator.
Practitioner.
Public Health.
Sanitarian.
Sei-i-Kwai Medical Journal.

Quarterly.

Deutsche Vierteljahrsschrift für öffentliche Gesundheitpflege.

Technology Quarterly and Proceedings of Society of Arts (Massachussetts).

Quarterly Journal of the Royal Meteorological Society.

LECTURES & MEETINGS,

JANUARY TO MARCH, 1894.

JANUARY.

1 M. Exhibition Committee, 5 p.m.

6 S. Lecture to Sanitary Officers, Nottingham, 3 p.m.

10 W. Finance Committee, 4 p.m.

10 W. Council Meeting, 5 p.m.

10 W. Sessional Meeting at 8 p.m. R. Thorne Thorne, C.B., on Diphtheria: its causes & prevention.

13 S. Lecture to Sanitary Officers, Nottingham, 3 p.m.

20 S. Lecture to Sanitary Officers, Nottingham 3 p.m.

22 M. Museum Committee, 5 p.m.

26 F. Lecture to Sanitary Officers, London, 8 p.m.

27 S. Lecture to Sanitary Officers, Nottingham, 3 p.m.

30 Tu. Lecture to Sanitary Officers, London, 8 p.m.

FEBRUARY.

2 F. Lecture to Sanitary Officers, London, 8 p.m.

3 S. Lecture to Sanitary Officers, Nottingham, 3 p.m.

3 S. Visit of the Students to Friern Barnet Sewage Works, 3 p.m.

5 M. Exhibition Committee, 5 p.m.

6 Tu. Lecture to Sanitary Officers, London, 8 p.m.

7 W. Visit of the Students to the Disinfecting Station, &c., at St. Pancras, 3 p.m.

9 F. Lecture to Sanitary Officers, London, 8 p.m.

FEBRUARY (*Continued*).

10 S. Lecture to Sanitary Officers, Nottingham, 3 p.m.

10 S. Visit of the Students to Express Dairy Co.'s Farm at Finchley, 3 p.m.

13 Tu. Lecture to Sanitary Officers, London, 8 p.m.

14 W. Visit of Inspection in the Parish of St. George's, Hanover Square, 2 p.m.

14 W. Finance Committee, 4 p.m.

14 W. Council Meeting, 5 p.m.

14 W. Sessional Meeting, 8 p.m. F. J. Waldo, M.D., on Sanitation of places where food is stored and prepared, in Bakehouses, Kitchens, and Restaurants.

16 F. Lecture to Sanitary Officers, London, 8 p.m.

17 S. Lecture to Sanitary Officers, Nottingham, 3 p.m.

17 S. Visit of the Students to Croydon Water Works and Beddington Sewage Farm, 2 p.m.

20 Tu. Lecture to Sanitary Officers, London, 8 p.m.

21 W. Visit of the Students to Guinness Buildings and Disinfecting Apparatus, Chelsea, 2 p.m.

23 F. Lecture to Sanitary Officers, London, 8 p.m.

26 M. Museum Committee, 5 p.m.

27 Tu. Lecture to Sanitary Officers, London, 8 p.m.

28 W. Visit of the Students to the Disinfecting Station, &c., at St Pancras, 3 p.m.

MARCH.

2 F. Lecture to Ladies, 3 p.m.

2 F. Lecture to Sanitary Officers, London, 8 p.m.

3 S. Visit of the Students to the East London Water Works, Lea Bridge.

5 M. Exhibition Committee, 5 p.m.

6 Tu. Lecture to Ladies, 3 p.m.

6 Tu. Lecture to Sanitary Officers, London, 8 p.m.

7 W. Visit of Inspection in the Parish of St. George's, Hanover Square, 2 p.m.

9 F. Lecture to Ladies, 3 p.m.

9 F. Examination Committee, 5 p.m.

9 F. Lecture to Sanitary Officers, London, 8 p.m.

10 S. Visit of the Students to the Ealing Sewage and Destructor Works, 2 p.m.

13 Tu. Lecture to Ladies, 3 p.m.

MARCH—(*Continued*).

13 Tu. Lecture to Sanitary Officers, London, 8 p.m.

14 W. Finance Committee, 4 p.m.

14 W. Council Meeting, 5 p.m.

14 W. Sessional Meeting at 8 p.m. R. Thorne Thorne, C.B., on Cholera.

14 W. Visit of the Students to Mitcham.

16 F. Lecture to Sanitary Officers, London, 8 p.m.

16 F.
17 S. } Examination, Nottingham.

17 S. Visit of the Students to the Barking Sewage Outfall Works.

19 M. Museum Committee, 5 p.m.

20 Tu. Lecture to Sanitary Officers, London, 8 p.m.

23 F. *Good Friday.*

26 M. *Easter Monday.*

30 F. Examination Committee, 5 p.m.

30 F. Lecture to Sanitary Officers, London, 8 p.m.

A subsequent list will be published giving Meetings for April and following months.

LIST OF HON. FELLOWS, FELLOWS, MEMBERS, AND ASSOCIATES.

Additions and Corrections to December 31*st*, 1893.

Hon. Fellows, 23; Fellows, 144;
Members, 497; Associates, 655.—Total, 1319.

HONORARY FELLOWS.

Reg. No.	Date of Election.	
		AUSTRIA-HUNGARY.
15	1890. June.	von Gruber, Prof. Franz Ritter, 1, *Tiefer Graben* 3, *Vienna.*
16	1890. June.	Fodor, Dr., *Professor of Hygiene, Buda-Pesth.*
		BELGIUM.
29	1890. June.	Putzeys, Dr. Felix, *Professor of Hygiene at the University of Liège.*
		EGYPT.
30	1890. Dec.	Greene, Dr. H. R., Pasha, *late Chief of the Sanitary Department, Cairo.*
		FRANCE.
31	1892. Oct.	Bechmann, M., *Ingénieur en Chef des Ponts et Chaussées; Directeur du Service d'Assainissement de Paris;* 9, *Place de l'Hôtel-de-Ville, Paris.*
2	1890. June.	Brouardel, Dr. Paul, *Prof. and Dean of the Faculty of Medicine, Paris.*
3	1890. June.	Cornil, Dr. V., *Senator*, 19, *Rue St. Guillaume, Paris.*
4	1890. June.	Pasteur, Prof. Louis, 25, *Rue Dutot, Paris.*
6	1890. June.	de Piétra Santa, Dr. Prosper, *Hon Sec. of the French Society of Hygiene*, 30, *Rue du Dragon, Paris.*
7	1890. June.	Vallin, Dr. Emile, *Professor of Hygiene, Director of the School of the Military Sanitary Service, Lyons.*
		GERMANY.
9	1890. June.	Hobrecht, Dr., *Engineer, Berlin.*
10	1890. June.	von Hofmann, Prof. A. W., *Professor of Chemistry, Berlin.*
11	1890. June.	Koch, Dr., *Director of the Hygienic Institute, Berlin.*
12	1890. June.	Pettenkofer, Dr., *Professor of Hygiene at the University of Munich.*
14	1890. June.	Virchow, Dr. Rudolph, *Professor of Pathology, Berlin.*

Reg. No.	Date of Election.	
		HOLLAND.
28	1890. June.	de Meyer, Dr. van Overbeek, *Professor of Hygiene at the State University of Utrecht, Netherlands.*
		ITALY.
18	1890. June.	Betocchi, Com$^{re.}$ Alessandro, Prof., *Civil Engineer, Ministry of Public Works, Rome.*
		ROUMANIA.
22	1890. June.	Felix, Dr. J., *Professor of Hygiene, Bucharest.*
		RUSSIA.
21	1890. June.	Suzor, Comte de, *Architect-in-chief, Ligue de Cadets* 21, *St. Petersburgh.*
		SWITZERLAND.
23	1890. June.	Guillaume, Dr., *Director of the Federal Bureau of Statistics, Berne.*
		TURKEY.
24	1890. June.	Zoëros, A., Pasha, *Professor at the School of Medicine, Director of the Bacteriological Institute, Secretary-General of the Administration of Public Medicine and Hygiene, Constantinople.*
		UNITED STATES.
25	1890. June.	Billings, Dr. John S., *Washington, D.C.*
27	1890. June.	Walcott, Dr. Henry P., *Cambridge, Massachusetts.*

FELLOWS (Fellow San. Inst.)

† Marked thus have passed the Examination of the Institute for Local Surveyors.

19	1889. Dec.	Abel, Sir Frederick, Bart., K.C.B., F.R.S., *Imperial Institute, Imperial Institute Road, S.W.*, (40, *Cadogan Place, S.W.*)
561	1891. Dec.	Acland, Sir Henry W., K.C.B., M.D., D.C.L., F.R.S., *Broad Street, Oxford.*
15	1888. Oct.	Adams, G. E. D'Arcy, M.D., D.P.H.CAMB., F.G.S., 1, *Clifton Gardens, Maida Vale, W.*
16	1888. Oct.	Albany, H.R.H. The Duchess of, *Claremont, Esher.*
316	1888 Oct.	Angell, Lewis, M.INST.C.E., F.K.C.LOND., *Town Hall, Stratford, E.*
27	1890. Feb.	Anningson, Bushell, M.A., M.D., *Cambridge.*
28	1889. Dec.	Armistead, William, M.B., M.O.H., *Shelford, Cambridgeshire.*
45	1889. Dec.	Barry, Charles, F.S.A., 1, *Victoria Street, S.W.*
366	1888. Dec.	Bass, Hamar Alfred, M.P., *Burton-on-Trent.*

Reg. No.	Date of Election.	
32	1888. Oct.	Bell, Major C. W., j.p., d.l., *Yewhurst, East Grinstead, Sussex.*
33	1888. Oct.	Birch, R. W. Peregrine, m.inst.c.e., 5, *Queen Anne's Gate, S.W.*
59	1889. Dec.	Blomfield, Sir A. W., m.a., f.r.i.b.a., 6, *Montague Place, W.*
34	1888. Oct.	Blyth, Prof. A. Wynter, m.r.c.s., l.s.a., *Court House, Marylebone, N.*
61	1888. Oct.	†Boulnois, H. Percy, m.inst.c.e., *City Engineer, Liverpool.*
67	1890. Jan.	Brett, A. T., m.d., m.o.h., *Watford House, Watford.*
35	1888. Oct.	Brighten, W. G., 108, *Fenchurch Street, E.C.*
328	1889. Dec.	Brock, J. H. E., m.d., b.sc.lond., 115, *Adelaide Road, South Hampstead, N.W.*
36	1888. Oct.	Brown, Harry, *The Elms, Worsley Road, Hampstead, N.W.*
37	1888. Oct.	Browning, Benjamin, l.r.c.p., m.r.c.s., d.p.h.camb., m.o.h., 16, *Royal Terrace, Weymouth.*
38	1888. Oct.	Burbery, J. Stone, *Trent House, West Cowes, I. of W.*
39	1888. Oct.	Burdett, Henry C., f.s.s., f.l.s., *The Lodge, Porchester Square, W.*
40	1888. Oct.	Burgess, Peter, m.a., m.b., *Driffield, Yorkshire.*
71	1888. Oct.	Cambridge, H.R.H. the Duke of, k.g., *Gloucester House, Park Lane, W.*
317	1888. Oct.	Carew, R. R., *Carpenders, Watford, Herts.*
73	1888. Oct.	Carter, R. Brudenell, f.r.c.s., 27, *Queen Anne Street, Cavendish Square, W.*
13	1888. Aug.	Cassal, Charles E., f.i.c., f.c.s., *Town Hall, Kensington, W.*, (*Vestry Hall, Mount Street, Grosvenor Square, W.*), (*Brenne House, Wandsworth Common, S.W.*).
80	1890. May.	Cates, Arthur, f.r.i.b.a., 7, *Whitehall Yard, S.W.*
318	1888. Oct.	Collins, H. H., f.r.i.b.a., 61, *Old Broad Street, E.C.*, (5, *Randolph Road, W.*).
87	1889. Dec.	Collins, Wm. J., m.d., b.sc.lond., d.p.h., 1, *Albert Terrace, Regent's Park, N.W.*
75	1888. Oct.	Colman, J. J., m.p., *Carrow House, Norwich.*
7	1888. Aug.	Corfield, Prof. W. H., m.a., m.d.oxon., f.r.c.p. lond., 19, *Savile Row, W.*
76	1888. Oct.	Crawford, Sir Thomas, m.d., k.c.b., q.h.s., ll.d., 5, *St. John's Park, Blackheath, S.E.*
96	1893. June.	†Crimp, W. Santo, m.inst.c.e., f.g.s., 27, *Great George Street, S.W.*
77	1888. Oct.	Cutler, Thomas William, f.r.i.b.a., 5, *Queen Square, Bloomsbury, W.C.*
101	1888. Oct.	Davey, Alexander George, m.d., l.r.c.p., m.r.c.s., 9, *Belvedere Street, Ryde, Isle of Wight.*
549	1891. Mar.	de Courcy Meade, Thomas, m.inst.c.e., *Belmont, Muswell Hill, Hornsey, N.*
103	1888. Oct.	Doulton, Sir Henry, *Lambeth, S.W.*

Reg. No.	Date of Election.	
113	1890. Feb.	Dowson, A., *Eastern Avenue, Reading.*
319	1888. Oct.	Doyle, Patrick, C.E., F.G.S., F.R.S.E., F.R.A.S., M.R.I.A, *Indian Engineering, Calcutta.*
11	1888. Aug.	Dudfield, T. Orme, M.D., L.R.C.P., M.R.C.S., 14, *Ashburn Place, Cromwell Road, S.W.*
104	1888. Oct.	Dyke, T. J., F.R.C.S., *The Hollies, Merthyr Tydfil.*
114	1888. Oct.	Eaton, John, M.D., *Montreal House, Cleator Moor, Cumberland.*
115	1888. Oct.	Ellis, W. Horton, F.R.MET.SOC.
384	1890. Dec.	Ewart, Joseph, M.D., F.R.C.P., J.P., *Montpelier House, Montpelier Terrace, Brighton, Sussex.*
119	1888. Oct.	Fayrer, Sir Joseph, K.C.S.I., M.D., F.R.C.P., F.R.C.S., LL.D., F.R.S., 53, *Wimpole Street, W.*
120	1888. Oct.	Field, Basil, B.A., 36, *Lincoln's Inn Fields, W.C.*
10	1888. Aug.	Field, Rogers, B.A., M.INST.C.E., 7, *Victoria Street, Westminster, S.W.*
121	1888. Oct.	Flower, Major Lamorock, *Lee Conservancy Board,* 12, *Finsbury Circus, E.C.* (48, *Holland Road, W.*).
355	1888. Nov.	Fortescue, Rt. Hon. Earl, 48, *Grosvenor Gardens, S.W.*, (*Castle Hill, South Molton, Devon*).
3	1888. Aug.	Galton, Sir Douglas, K.C.B., D.C.L., LL.D., F.R.S., 12, *Chester Street, Grosvenor Place, S.W.*
132	1888. Oct.	Gowers, Wm. Richard, M.B., 50, *Queen Anne St., W.*
134	1888. Oct.	Grimshaw, Thomas Wrigley, M.D., *Priorsland, Carrickmines, Dublin.*
337	1893. Jan.	Hall, Edwin Thomas, F.R.I.B.A., 57, *Moorgate Street, E.C.*
141	1888. Oct.	Harker, J., M.D., J.P., *Hazel Grove, Carnforth, Lanc.*
142	1888. Oct.	Harris, Thomas, F.R.I.B.A., 6, *Southampton Street, Bloomsbury Square, W.C.*
150	1890. Jan.	Harrison, C., M.D., D.P.H.CAMB., *Newland, Lincoln.*
143	1888. Oct.	Hart, Ernest, 38, *Wimpole Street, W.*
144	1888. Oct.	Haviland, A., M.R.C.S., *Egremont House, Delamere Terrace, W.*
388	1890. June.	Hehir, Patrick, M.D., F.R.C.S., D.P.H., *Hyderabad, Deccan, India.*
154	1890. Jan.	Hill, Alfred, M.D., M.R.C.S., L.S.A., *The Council House, Birmingham.*
614	1893. June.	Hill, Prof. Alfred Bostock, M.D., D.P.H., M.O.H., 14, *Temple Street, Birmingham; and Elmhurst, Olton, Birmingham.*
367	1888. Dec.	Hime, Thomas Whiteside, A.B., M.B., L.R.C.S., 54, *Horton Road, Bradford.*
146	1888. Oct.	Hodson, George, M.INST.C.E., F.G.S., *Abbey Buildings, Princes Street, Westminster, S.W.* (*Loughborough*).
160	1889. Dec.	Hope, E. W., M.D., D.P.H., *Municipal Offices, Liverpool.*
147	1888. Oct.	Humphry, Sir G. M., M.D., F.R.S., *Cambridge.*
164	1889. Dec.	Hunter, Sir William Guyer, K.C.M.G., M.D., F.R.C.P., 21, *Norfolk Crescent, Hyde Park, W.*

Reg. No.	Date of Election.	
165	1890. Jan.	ILIFFE, William, M.R.C.S., 41, *Osmaston Street, Derby.*
166	1888. Oct.	JONES, LIEUT.-COL. A. S., V. C., ASSOC.M.INST.C.E., *Culverside, Carshalton, Surrey.*
6	1888. Aug.	JUDGE, Mark H., A.R.I.B.A., 15, *Connaught Square, W.*
167	1888. Oct.	KELLY, Charles, M.D., F.R.C.P., *Ellesmere, Gratwicke Road, Worthing.*
368	1888. Dec.	KINGDON, J. A., *Grocer's Hall, E.C.*
169	1888. Oct.	LATHAM, Baldwin, M.INST.C.E., F.R.MET.SOC., F.G.S., F.S.S., 13, *Victoria Street, S.W., (Duppas House, Croydon).*
170	1888. Oct.	LAW, Henry, M.INST.C.E., F.R.MET.SOC., 17, *Victoria Street, S.W., (70, St. George's Road, Pimlico).*
176	1889. Dec.	LAWRENCE, SIR Trevor, BART., M.P., 57, *Prince's Gate, S.W.*
172	1888. Oct.	LEAF, Charles J., F.L.S., F.S.A., 6, *Sussex Place, Regent's Park, N.W.*
370	1888. Dec.	LEAF, W., LITT.DOC., 6, *Sussex Place, Regent's Park, N.W.*
178	1893. June.	LEMON, James, M.INST.C.E., F.R.I.B.A., F.S.I., F.G.S., *Lansdowne House, Southampton; and Palace Chambers, Westminster, S.W.*
5	1888. Aug.	LEWIS, PROF. T. Hayter, F.S.A., F.R.I.B.A., 12, *Kensington Gardens Square, S.W.*
173	1888. Oct.	LIVESEY, J., M.INST.C.E., 2, *Victoria Mansions, Victoria Street, Westminster, S.W.*
369	1888. Dec.	LONGSTAFF, G. B., M.D., M.A., D.P.H., *Highlands, Putney Heath, S.W., (Twitchen, Morthoe, R.S.O., N. Devon).*
371	1888. Dec.	LUBBOCK, RT. HON. SIR John, BART., M.P., D.C.L., F.R.S., *Lombard Street, E.C.*
186	1888. Oct.	MACKEY, John Alexander Dixie, B.A.OXON., 1, *Westbourne Terrace, W.*
187	1888. Oct.	MANSERGH, James, M.INST.C.E., 5, *Victoria Street, S.W.*
200	1893. Jan.	†MAWBEY, Enoch George, ASSOC.M.INST.C.E., *Town Hall, Leicester.*
188	1888. Oct.	MEATH, RT. HON. EARL OF, 83, *Lancaster Gate, Hyde Park, W.*
202	1892. Oct.	MIDDLETON, Reginald Empson, M.INST.C.E., F.S.I., 17, *Victoria Street, S.W.*
214	1890. Jan.	MURPHY, Shirley F., M.R.C.S., 22, *Endsleigh Street, Tavistock Square, W.C.*
504	1890. June.	NEWSHOLME, Arthur, M.D., D.P.H., M.R.C.P., M.O.H., 15, *College Road, Brighton, (Town Hall, Brighton).*
373	1888. Dec.	NIGHTINGALE, Miss F., 10, *South Street, Grosvenor Square, W.*
397	1890. May.	NORTH, Samuel W., M.R.C.S., F.G.S., M.O.H., *Micklegate, York.*
1	1888. Aug.	NORTHUMBERLAND, HIS GRACE THE DUKE OF, K.G., D.C.L., LL.D., 2, *Grosvenor Place, S.W.*

Reg. No.	Date of Election.	
551	1890. Nov.	NOTTER, PROF. J. Lane, M.A., M.D., D.P.H., *West Cliffe, Woolston, Southampton.*
221	1888. Oct.	OHREN, Magnus, ASSOC.M.INST.C.E., F.C.S., *Lower Sydenham, S.E.*
322	1888. Oct.	OLLARD, J. F., *Maragion, Cornwall.*
222	1888. Oct.	OLLARD, William Ludlam, *Musticott House, Walsoken, Wisbeach, Norfolk.*
229	1889. Nov.	PAGET, Charles Edward, M.R.C.S., D.P.H., M.O.H., *Town Hall, Salford.*
223	1888. Oct.	PAGET, J., J.P., *Stuffynwood, Mansfield.*
12	1888. Aug.	PARKES, Charles Henry, *Netherfield, Weybridge.*
224	1888. Oct.	PARKES, Louis Coltman, M.D., M.R.C.S., D.P.H., 61, *Cadogan Square, S.W.*
225	1888. Oct.	PEGGS, J. Wallace, ASSOC.M.INST.C.E., 9, *Welbeck Mansions, Cadogan Terrace, S.W.*, (*Southbourne Lodge, near Christchurch, Hants*).
226	1888. Oct.	PLUMBE, Rowland, F.R.I.B.A., 13, *Fitzroy Square, W.*
14	1888. Aug.	POORE, George Vivian, M.D., F.R.C.P., 30, *Wimpole Street, W.*
401	1890. Jan.	POWELL, SIR Francis Sharp, BART., M.P., 1, *Cambridge Square, W.*, (*Horton Old Hall, Bradford*).
227	1888. Oct.	PRITCHARD, E., M.INST.C.E., F.G.S., 1, *Victoria Street, S.W.*, (37, *Waterloo Street, Birmingham*).
244	1888. Oct.	RAWLINSON, SIR Robert, K.C.B., M.INST.C.E., 11, *The Boltons, Brompton, S.W.*
250	1890. Feb.	REDWOOD, T. Hall, M.D., *The Lawn, Rhymney.*
608	1891. Oct.	REID, George, M.D., D.P.H., *County Medical Officer of Health, Stafford.*
323	1888. Oct.	REYNOLDS, PROF. J. Russell, M.D., F.R.C.P., F.R.S., 38, *Grosvenor Street, W.*
356	1888. Nov.	RICHARDSON, SIR Benjamin Ward, M.D., LL.D., F.R.S., 25, *Manchester Square, W.*
245	1888. Oct.	RICHARDSON, J., M.INST.C.E., *Methley Park, Leeds.*
252	1890. Jan.	RIPON, MOST HON. MARQUESS OF, K.G., D.C.L., F.R.S., 9, *Chelsea Embankment, S.W.*
246	1888. Oct.	ROBINS, Edward Cookworthy, F.S.A., F.R.I.B.A., 46, *Berners Street, W.*
247	1888. Oct.	ROBINSON, PROF. Henry, M.INST.C.E., 13, *Victoria Street, S.W.*, (54, *Boundary Road, N.W.*).
621	1892. Oct.	ROCHE, Antony, M.R.C.P.I., L.R.C.S.I., 72, *Harcourt Street, Dublin, Professor of Hygiene and also of Medical Jurisprudence in the Catholic University, Examiner in Sanitary Science, Royal University, Dublin.*
248	1888. Oct.	RUSSELL, HON. F. A. Rollo., F.R.MET.SOC., *Dunrozel, Haslemere.*
324	1888. Oct.	RUSSELL, James A., M.A., F.R.C.P.EDIN., M.B., B.SC., F.R.S.E., *Woodville, Canaan Lane, Edinburgh.*
256	1890. Jan.	RUSSELL, J. B., M.D., LL.D., M.O.H., *Glasgow.*
417	1889. Jan.	SALT, Thomas, M.P., 85, *St. George's Square, S.W.*

Reg. No.	Date of Election.	
265	1889. Dec.	Seaton, Edward Cox, M.D., F.R.C.S., *The Limes*, 56, *North Side, Clapham Common, S.W.*
325	1888. Oct.	Shaw, George, 20, *King Edward Street, Newgate Street, E.C.*
374	1888. Dec.	Sieveking, Sir E. H., M.D., 17. *Manchester Sq., W.*
347	1889. Nov.	Smith, James, Osborne, A.R.I.B.A., 34, *Southampton Street, Strand, W.C.*, (65, *Frithfield Gardens, Uxbridge Road, W.*).
492	1892. Oct.	Smith, William Howard, ASSOC.M.INST.C.E., *City Engineer and Surveyor, Carlisle.*
257	1888. Oct.	Smith, Prof. William Robert, M.D., F.R.S.E., D.SC., *Barrister-at-Law*, 74, *Great Russell Street, W.C.*, (*Plumstead, Kent*).
258	1888. Oct.	Snell, H. Saxon, F.R.I.B.A., 22, *Southampton Buildings, W.C.*, (*Lynden Lodge, Elmfield Rd., Bromley, Kent*).
460	1889. Mar.	Stephens, Henry C., M.P., *Avenue House, Finchley.*
260	1888. Oct.	Strong, Henry John, M.D., *Colonade House, The Steyne, Worthing.*
261	1888. Oct.	Sykes, J. F. J., D.SC., M.D., 40, *Camden Square, N.W.*
4	1888. Aug.	Symons, G. J., F.R.S., 62, *Camden Square, N.W.*
285	1889. Dec.	Taylor, J. Stopford, M.D., 6, *Grove Park, Liverpool.*
280	1888. Oct.	Temple, Right Rev. Frederick, D.D., Lord Bishop of London, *The Palace, Fulham, S.W.*
291	1889. Dec.	Thompson, Sir Henry, M.B., 35, *Wimpole Street, W.*
282	1888. Oct.	Thorne, R. Thorne, C.B., M.B., F.R.C.P., F.R.S., 45, *Inverness Terrace, W.*
283	1888. Oct.	Turner, Ernest, F.R.I.B.A., 246, *Regent Street, W.*
8	1888. Aug.	Twining, Thomas, *Perryn House, Twickenham.*
413	1891. Nov.	Vacher, Francis, F.R.C.S., *Birkenhead.*
301	1889. Dec.	Walford, Edward, M.D., D.P.H.CAMB., M.R.C.S., M.O.H., *Town Hall, Cardiff.*
295	1888. Oct.	Waring, Col. G. E., Jun., M.INST.C.E., *Newport, Rhode Island, U.S. America.*
296	1888. Oct.	Waterhouse, Alfred, R.A., 20, *New Cavendish Street, W.*
2	1888. Aug.	Westminster, His Grace the Duke of, K.G., *Grosvenor House, W.*
297	1888. Oct.	Whitelegge, Benjamin Arthur, M.D., B.SC., D.P.H.CAMB., *St. John's, Wakefield.*
298	1888. Oct.	Williams, Dawson, M.D., 25, *Old Burlington St., W.*
299	1888. Oct.	Wilson, George, M.A., M.D., F.R.S.E., 7, *Avon Place, Warwick.*
418	1889. Jan.	Wix, H. A., 3, *King's Bench Walk, Temple, E.C.*

ORDINARY MEMBERS (Mem. San. Inst.)

† Marked thus have passed the Examination of the Institute for Local Surveyors.

‡ Marked thus have passed the Examination of the Institute for Inspectors of Nuisances.

Reg. No.	Date of Election.	
464	1889. Mar.	Adams, James, m.d., m.o.h., *Springwell, Barnes, S.W.*
665	1891. Dec.	Adams, Prof. Henry, m.inst.c.e., f.s.i., 60, *Queen Victoria Street, E.C.*
465	1889. Mar.	Adkins, George, l.r.c.p.lond., d.p.h., m.o.h., *The Elms, Paignton, South Devon.*
451	1889. Feb.	Aldwinckle, Thomas William, f.r.i.b.a., 1, *Victoria Street, S.W.*
352	1888. Oct.	Alexander, W. C., *Aubrey House, Campden Hill, W.*
21	1888. Oct.	Ames, H. St. Vincent, m.a., *Cote House, Westbury-on-Trym, Bristol.*
22	1888. Oct.	Anderson, Geo., c.e., 35*a*, *Great George Street, Westminster, S.W.*
440	1889. Jan.	†Anderson, John Reid, *The Cottage, Gibson's Hill, Norwood, S.E.*
611	1890. Dec.	Anderson, John, assoc.m.inst.c.e., *Town Hall, Montrose, N.B.*
23	1888. Oct.	Andresen, August F., *Priory Cottage, Mill Lane, West Hampstead, N.W.*
24	1888. Oct.	Andrew, Capt. C. W., *Rutland House*, 5, *The Terrace, Kennington Park, S.E.*
455	1889. Mar.	Andrews, G. R., *Surveyor, Johannesburg, South Africa.*
25	1888. Oct.	Andrews, Jonathan, 10a, *Mount Street, Berkeley Square, W.*
26	1888. Oct.	†Angell, John A., assoc.m.inst.c.e., *Borough Engineers' Office, West Ham, E.*
555	1889. Nov.	Anson, Frederick Henry, m.a., assoc.m.inst.c.e., 15, *Dean's Yard, Westminster, S.W.*
752	1892. Dec.	Argles, Frank, m.r.c.p., m.o.h., *Wanstead, Essex.*
646	1891. Oct.	Armstrong, Henry E., d.hyg., m.r.c.s., l.s.a., m.o.h., *The Health Department, Town Hall, Newcastle-on-Tyne.*
29	1888. Oct.	Armstrong, Prof. H. E., ph.d., f.r.s., 55, *Granville Park, Lewisham, S.E.*
601	1890. Oct.	Aspinall, Miles, *Borough Engineer and Surveyor's Office, Worthing.*
652	1891. Nov.	Atkins, Alfred, assoc.m.inst.c.e., f.r.i.b.a., *Wanganui, New Zealand.*
31	1888. Oct.	Aumonier, F., 110, *High Street, Manchester Square, W.*
674	1892. Jan.	Bailey, Thomas Castley, l.r.c.p., m.r.c.s., m.o.h., *Crewe, Cheshire.*

Reg. No.	Date of Election.	
696	1892. Mar.	Baine, Laurence Augustus, M.D., D.P.H., *Dipton, Lintz Green, Durham.*
41	1888. Oct.	Baker, Sir Benjamin, K.C.M.G., LL.D., F.R.S., M.INST.C.E., 2, *Queen's Square Place, Westminster.*
42	1888. Oct.	Baker, R., *Ballingdon House, Green Lanes, N.*
683	1892. Feb.	Barclay, Arthur, ASSOC.M.INST.C.E., 34, *Fitzroy Rd., Primrose Hill, N.W.*
791	1893. Nov.	Barrett, Ernest James, ASSOC.M.INST.C.E., *Borough Surveyor's Office, Richmond, Surrey.*
634	1891. July	Barwise, Sidney, M.D., D.P.H., M.O.H., *Derbyshire County Council*, 61, *Uttoxeter New Road, Derby.*
782	1893. Oct.	†Bassett, Gilbert Thomas, *Highfield Road, Saltley, Birmingham.*
591	1890. May.	‡Bateman, James, *Civil Engineer*, 27, *Exchange Buildings, Johannesburg, South Africa.*
47	1888. Oct.	Baugh, Alfred C., *Egerton Street, Wrexham, North Wales.*
48	1888. Oct.	Bean, Alexander Thomas, 7, *Victoria Street, S.W.*
376	1888. Dec.	†Beard, E. T., *Wallsend, Pevensey, Sussex.*
351	1888. Oct.	Beard, George, *Thickthorn, Kenilworth.*
49	1888. Oct.	Beard, Neville, *The Mount, Ashbourne.*
564	1889. Dec.	Beardmore, George Russell, L.R.C.P.LOND., M.R.C.S., L.S.A., D.P.H.CAMB., *Warwick House, Upper Street, Islington, N.*
50	1888. Oct.	Beddoe, John, B.A., M.D., F.R.S., *The Chantry, Bradford-on-Avon.*
51	1888. Oct.	Bell, Thomas, L.R.C.P.LOND., *Uppingham, Rutland.*
415	1888. Dec.	‡Benjamin, Horace Bernton, F.R.G.S., 28, *Albemarle Street, W.*, (37, *Upper Grosvenor Street, W.*).
52	1888. Oct.	Bennett, Hugh, M.R.C.S., *Builth Wells, Brecon.*
690	1892. Mar.	Bennett, William Benjamin George, ASSOC.M.INST. C.E., *Cranleigh, Portswood Road, Southampton.*
53	1888. Oct.	Bernard, William Larkins, F.R.I.B.A., 3, *St. Stephen's Chambers, Baldwin Street, Bristol.*
54	1888. Oct.	†Berrington, R. E. W., ASSOC.M.INST.C.E., *Graiseley, Wolverhampton.*
694	1892. Mar.	Berry, William Walton, ASSOC.M.INST.C.E., *Eccles, near Manchester.*
56	1888. Oct.	Bickersteth, E. R., F.R.C.S., 2, *Rodney Street, Liverpool.*
619	1891. Mar.	Billingham, J. A. L., *Surveyor, R. Engineers, Royal Engineer Office, Colombo.*
57	1888. Oct.	Black, Surg.-Major W. G., 2, *George Square, Edinburgh.*
467	1889. Mar.	Blair, William Nisbet, ASSOC.M.INST.C.E., *Vestry Hall, Pancras Road, N.W.*
58	1888. Oct.	Blashill, T., F.R.I.B.A., *Superintending Architect, London County Council, Spring Gardens, S.W.*
730	1892. Oct.	Blizard, John Henry, ASSOC.M.INST.C.E., F.S.I., *Castle Lane, Southampton.*

Reg. No.	Date of Election.	
466	1889. Mar.	Blumer, Frederick Milnes, B.A., M.B., M.O.H., *St. Mary's Grove, Stafford.*
447	1889. Feb.	Bolding, John T., 19, *South Moulton Street, W.*
60	1888. Oct.	Bond, Fredk. Adolphus, M.B., C.M.EDIN., D.P.H.EDIN., *Hetton Lodge, Ferndale, Tunbridge Wells.*
583	1890. Apr.	Boobbyer, Philip, M.B., M.R.C.S., M.O.H., *The Guildhall, Nottingham.*
377	1888. Dec.	Bostock, H., *The Oaklands, Rowley Avenue, Stafford.*
62	1888. Oct.	Box, M. H.
65	1888. Oct.	Bradshaw, James D., B.A., M.B., M.R.C.P., M.R.C.S., 30, *George Street, Hanover Square, W.*
635	1891. July.	Braga, João Francisco, L.S.A., F.C.S., F.L.S., F.G.S., D.P.H., *Glen Villa, Sunbury-on-Thames.*
469	1889. Mar.	Brebner, George Reith, M.D., D.P.H., *Bensham Lodge, West Croydon, S.W.*
68	1888. Oct.	Bridges, J. H., M.B., F.R.C.P., 28, *Ladbroke Gardens, Notting Hill, W.*
617	1891. Jan.	Bright, Philip, ASSOC.M.INST.C.E., 2, *Newgate Street, E.C.*
357	1888. Nov.	Bristowe, John Syer, M.D., F.R.S., 13, *Old Burlington Street, W.*
506	1889. Apr.	Brodie, John Shanks, ASSOC.M.INST.C.E., *Town Hall, Whitehaven, Cumberland.*
498	1889. Mar.	Brooke, Walter, ASSOC.M.INST.C.E., *Albany Buildings,* 39, *Victoria Street, Westminster, S.W.*
517	1889. Apr.	Brooke, Wm., M.D., M.O.H., *Crompton Local Board, Shaw, near Oldham.*
671	1892. Jan.	Brown, Arthur, M.INST.C.E., *The Guildhall, Nottingham.*
728	1892. Oct.	†‡Brown, Edwin, *Local Board Offices, Burgess Hill.*
765	1893. Apr.	Brown, Thomas, *Alderman Norfolk County Council, King's Lynn, Norfolk.*
69	1888. Oct.	Brown, William Ibbs, *St. Michael's Avenue and Guildhall, Northampton.*
774	1893. July.	Brownridge, Charles, ASSOC.M.INST.C.E., F.G.S., *Borough Engineer of Birkenhead, Cheshire.*
70	1888. Oct.	Bryant, Thomas, F.R.C.S., 65, *Grosvenor Street, W.*
379	1888. Dec.	Buckton, Mrs. 27, *Ladbroke Square, W.*
629	1891. May.	Bullis, William Daniel, *Surveyor,* 21, *Finsbury Pavement, E.C.*
633	1891. July.	Bulstrode, Herbert Timbrell, M.A., M.D., D.P.H. *Local Government Board, Whitehall, S.W.*
416	1888. Dec.	†Bunten, Charles, *St. Bernard, Cambridge Road, Aldershot.*
582	1890. Apr.	Burdwood, James Watson, L.F.P.S., M.O.H., *West Cottage, Bourne, Lincoln.*
711	1892. May.	Burgess, Samuel Edwin, ASSOC.M.INST.C.E., *Town Hall, Banbury.*
380	1888. Dec.	Burmester, Miss E., 13, *Sussex Square, Hyde Park, W.*
567	1890. Jan.	Burr, Alfred, F.R.I.B.A., 85, *Gower Street, W.C.*

Reg. No.	Date of Election.	
514	1889. Apr.	Burton, Samuel Hubert, F.R.C.S., M.O.H., 50, *St. Giles's Street, Norwich.*
419	1889. Jan.	†Burton, W. Kinninmond, ASSOC.M.INST.C.E. *Professor of Sanitary Engineering, Imperial University, Tokio, Japan.*
777	1893. July.	†‡Busbridge, Harold, 96, *Herbert Road, Plumstead, Kent.*
714	1892. June.	Button, Fred Smith, ASSOC.M.INST.C.E., *Town Hall, and* 13, *Palatine Square, Burnley.*
783	1893. Oct.	†Cameron, Donald, *City Engineer*, 1, *Sylvan Road, Exeter.*
453	1889. Feb.	†Campbell, Adam Horsburgh, ASSOC.M.INST.C.E., *Borough Surveyor's Office, Stratford-on-Avon.*
78	1888. Oct.	Campbell, Charles, 7, *Grange Road, Sheffield.*
329	1888. Oct.	Campbell, Hon. Dudley, 1, *Mitre Court Buildings, Temple.*
470	1889. Mar.	Campbell, Kenneth Findlater, ASSOC.M.INST.C.E., *Borough Engineer, Stockton-on-Tees.*
745	1892. Nov.	Canty, William Henry, 24, *Cambridge Street, Prospect Hill, Tunbridge Wells, Kent.*
79	1888. Oct.	Carline, John, ASSOC.M.INST.C.E., *Board of Works, Lewisham, S.E.*
358	1888. Nov.	Carritt, Ernest, 18 *&* 19, *Great St. Helens, E.C.*
680	1892. Feb.	Carroll, Joseph, M.B., C.M., D.P.H., M.O.H., 172, *Station Road, Ilkeston.*
708	1892. May.	Caws, Edward Isaac, *Coronation, Sea View, Isle of Wight.*
607	1890. Nov.	Chart, Robert Masters, *Mitcham, Surrey.*
81	1888. Oct.	Chatterton, George, M.INST.C.E., 46, *Queen Anne's Gate, S.W.*
82	1888. Oct.	Chattock, Miss Frances C., *Solihull, Birmingham.*
758	1893. Jan.	Chewett, James Henry, C.E., *of Toronto University, Toronto, Ontario, Canada; and The Nest, Poplar Plains Road, Toronto.*
83	1888. Oct.	Clarke, James Wright, 8, *Salcott Road, Wandsworth, S.W.*
84	1888. Oct.	Clarkson, J. W., M.R.C.S.E., L.R.C.P.L., *c/o Messrs. H. S. King & Co., Pall Mall, S.W.*
598	1890. Oct.	†Clothier, Samuel Thompson, *Street, Somerset.*
701	1892. Apr.	Coales, Herbert George, ASSOC.M.INST.C.E., *Market Harborough, Leicester.*
85	1888. Oct.	Coates, C., F.R.C.P., 10, *Circus, Bath.*
86	1888. Oct.	Cock, Frederick, M.D., 1, *Porchester Houses, Porchester Square, W.*
332	1888. Oct.	Collingridge, W., M.A., M.D., D.P.H., *Port of London Sanitary Offices, Greenwich, S.E.*
330	1888. Oct.	Collinson, John, 21, *Ashley Gardens, Victoria Street, S.W.*
88	1888. Oct.	†Comber, P. F., M.INST.C.E.IRELAND, 19, *Lower Leeson Street, Dublin.*

Reg. No. Date of Election.

726 1892. Sept. †CONNAL, Eben, M.INST.C.E., 49, *Kerrsland Terrace, Hillhead, Glasgow, Lanark, Scotland.*
89 1888. Oct. †COOPER, C. H., ASSOC.M.INST.C.E., *Local Board Offices, Wimbledon, S.W.*
90 1888. Oct. COOPER, Francis A., ASSOC.M.INST.C.E., *Director of Public Works, and Resident Engineer, Hong Kong, (c/o H. F. Cooper, Nottingham and Notts Bank, Newark).*
359 1888. Nov. COOPER, John, jun., *Croydon, S.W.*
443 1889. Jan. †COOPER, William, 32, *Cheetham Street, Cheetham, Manchester.*
91 1888. Oct. CORBETT, Joseph, *Borough Engineer, Town Hall, Salford.*
666 1891. Dec. CORNER, John, 83, *Lavender Sweep, Clapham Junction, S.W.*
688 1892. Mar. CORNISH, William Robert, SURG.-GEN., F.R.C.S., C.I.E., Q.H.P., 8, *Creswell Gardens, S.W.*
92 1888. Oct. CORSAN, John R., 80, *Gray's Inn Road, W.C.*
93 1888. Oct. COURTNEY, MAJOR D. C., R.E., 22, *Collingham Gardens, Kensington, S.W.*
545 1889. Oct. COWAN, Peter Chalmers, B.SC. (EDIN.), ASSOC.M.INST.C.E., *County Surveyor, Downpatrick.*
94 1888. Oct. COWTAN, Frank, 309, *Oxford Street, W.*
597 1890. Oct. †‡CRAIG, G. A., *Market Drayton, Salop.*
95 1888. Oct. CRANBROOK, THE RT. HON. VISCOUNT, G.C.S.I., 17, *Grosvenor Crescent, S.W.*
755 1893. Jan. CREER, Alfred, ASSOC.M.INST.C.E., *City Engineer, The Guildhall, York.*
540 1889. June. CREGEEN, Hugh Stowell, 42, *Freelands Road, Bromley, Kent.*
631 1891. June. CRISP, James Gregory, *Angle Villa, Leckhampton, Cheltenham.*
98 1888. Oct. CROWLEY, Frederick, *Ashdell, Alton, Hants.*
472 1889. Mar. CUFF, Robert, M.B., M.R.C.S., M.O.H., 28, *Huntriss Row, Scarborough.*
100 1888. Oct. †CURWEN, John F., F.R.I.B.A., 51, *Highgate, Kendal.*
577 1890. Mar. DABBS, George Henry Roque, M.D., M.R.C.S., M.O.H., *Highfields, Shanklin, I. of Wight.*
105 1888. Oct. †DARCH, John, 74, *Sarsfield Road, Balham, S.W.*
709 1892. May. DAVIS, Alfred T., ASSOC.M.INST.C.E., *Shirehall, Shrewsbury.*
756 1893. Jan. DAVIS, George Brown, *Cambridge House, South Lambeth Road, S.W.*
599 1890. Oct. †DAVIS, Neville Brookes, ASSOC.M.INST.C.E., P.A.SURV. INST., *Water Works Office, Leicester.*
106 1888. Oct. DAWSON, Charles James, F.R.I.B.A., *Surveyor to the Local Board, Barking, Essex.*
108 1888. Oct. DAY, Ernest, F.R.I.B.A., 5, *Foregate Street, Worcester.*
731 1892. Oct. †DAYE, John, 117, *Arran Street, Roath, Cardiff.*

Reg. No.	Date of Election.	
109	1888. Oct.	DEBENHAM, F. G., *Cheshunt Park, Herts.*
107	1888. Oct.	DE CHAUMONT, Miss Anna Kennedy Francois, 86, *Abingdon Road, Kensington, W.*
724	1892. Sept.	†DENDY, William Cooper, P.A.S.I., *Surveyors' Department, Lambeth Vestry, Kennington Green, S.E.*
110	1888. Oct.	DENNIS, Nelson F., *Town Surveyor, West Cowes.*
699	1892. Apr.	DICKINSON, Thomas Rusholm, ASSOC.M.INST.C.E., *Borough Surveyor, Hertford, Herts.*
698	1892. Jan.	DICKINSON, William Gilbert, L.R.C.P., M.R.C.S., D.P.H., 1, *Wimbledon Road, Southfields, Wandsworth, S.W.*
532	1889. May.	DIXEY, Harry Edward, M.D., *Woodgate, Great Malvern.*
725	1892. Sept.	†DIXON, Francis Edward, *Local Board Offices, Bamber Bridge in Walton-le-Dale, Lancaster.*
627	1891. May.	DODD, Peter, ASSOC.M.INST.C.E., *Engineer and Surveyor, Wandsworth, S.W.*
520	1889. Apr.	DONOVAN, Dennis D., L.R.C.P., L.R.C.S., *Superintendent Medical Officer of Health, City of Cork.*
112	1888. Oct.	DOULTON, James, *Lambeth, S.W.*
616	1891. Jan.	DRAYSON, Walter B. H., 2, *Newgate Street, E.C.*
516	1889. Apr.	EATON-SHORE, George, ASSOC.M.INST.C.E., *Borough Engineer*, 190, *Edlestone Road, Crewe.*
334	1888. Oct.	ECCLES, Miss Jane Helen, 3, *Dean's Yard, Westminster, S.W.*
618	1891. Feb.	EDGE, Frederic James, ASSOC.M.INST.C.E., *Public Offices, Cleator Moor, Cumberland.*
784	1893. Oct.	†ELFORD, Ernest J., *The City Engineer's Office, Norwich, Norfolk.*
118	1888. Oct.	ELFORD, John, *Borough Surveyor, Poole, Dorset.*
713	1892. June.	ELLIOT, SURG.-LIEUT. Robert Henry, M.B., B.S.LOND., F.R.C.S.ENG., D.P.H.CANTAB., L.R.C.P.LOND., *Madras Infantry, Deccan, India.*
383	1888. Dec.	EMERSON, W., F.R.I.B.A., 8, *The Sanctuary, S.W.*
692	1892. Mar.	ENTWISTLE, Henry, *Local Board Offices, Swinton, Lancaster.*
420	1889. Jan.	ERICHSEN, J. Eric, F.R.S., 6, *Cavendish Place, W.*
360	1888. Nov.	EVERS, SURG.-LIEUT.-COL. B., M.D., C.M., D.P.H.CAMB. *care of Messrs. Watson Bros.*, 27, *Leadenhall Street, E.C.*
421	1889. Jan.	FARRER, LORD, 27, *Bryanston Square, W.*
695	1892. Mar.	FARRINGTON, William, *Town Hall, Hoyland Nether, Yorkshire.*
754	1893. Jan.	FAWCETT, Edmund Alderston Sandford, ASSOC.M.INST.C.E., 13, *Victoria Street, S.W.*
123	1888. Oct.	FAWCETT, William Milner, M.A., F.R.I.B.A., 1, *Silver Street, Cambridge.*
637	1891. July.	†‡FELKIN, Howard Riley, 23, *Brackley Road, Chiswick.*
125	1888. Oct.	FIELD, Horace, 14, *Gray's Inn Square, W.C.*

Reg. No. Date of Election.

127 1888. Oct. Fisher, T. J., 50, *Thorne Road, South Lambeth, S.W.*

721 1892. Sept. Fletcher, Walter John, F.R.I.B.A., *Wimborne, Dorset.*

639 1891. Oct. †‡Flower, Thomas James Moss, *Carlton Chambers, Baldwin Street, Bristol.*

128 1888. Oct. Forde, H. C., M.INST.C.E., 4, *Great Winchester Street, E.C.*

630 1891. May. Fosbroke, G. H., M.R.C.S., D.P.H., *County Medical Officer of Health, Rose Place, near Worcester.*

129 1888. Oct. Foster, Reginald Le Neve, F.C.S., *North Road, Droylsdon, Manchester.*

743 1892. Nov. Fowler, Alfred Mountain, M.INST.C.E., 1, *St. Peter's Square, Manchester.*

130 1888. Oct. Frank, Philip, M.D., *Cannes, France.*

131 1888. Oct. Fraser, James, M.INST.C.E., 100, *Castle Street, Inverness, N.B.*

422 1889. Jan. Fraser, W. J., ASSOC.M.INST.C.E., 98, *Commercial Road, E.*

135 1888. Oct. Galton, Francis, F.R.S., 42, *Rutland Gate, S.W.*

474 1889. Mar. Gange, Frederick A., M.D., M.O.H., *Faversham, Kent.*

732 1892. Oct. Gay, John, M.R.C.S., L.R.C.P., D.P.H., 119, *Upper Richmond Road, Putney, S.W.*

136 1888. Oct. †Geen, Harry, *Hillside, Okehampton, Devon.*

636 1891. July. †‡Gibbs, Arthur Gordon, *Surveyor's Office, Midhurst.*

560 1889. Dec. †Gibson, William, *Bonhay Road, Exeter.*

441 1889. Jan. †Gilby, Charles, *Bath.*

137 1888. Oct. Gill, D., *Farleigh, Weston-super-Mare.*

650 1891. Nov. Gilliland, William John, *Architect*, 74, *Royal Avenue, Belfast.*

385 1888. Dec. Gladstone, J. H., PH.D., F.R.S., 17, *Pembridge Square, W.*

676 1892. Jan. Glaister, John, M.D., D.P.H., 101, *Great Russell Street, W.C.*

386 1888. Dec. Glen, A. W., 33, *Davies Street, Berkeley Square, W.*

573 1890. Mar. Godfrey, Robt., ASSOC.M.INST.C.E., *Silverhow, King's Heath, Birmingham.*

613 1891. Jan. Going, Joseph A., M.R.C.S., B.A., M.O.H., *Fox Bay, West Falkland Islands, South America.*

516 1889. Nov. Goodyear, Herbert, ASSOC.M.INST.C.E., *Colchester, Essex.*

518 1889. Apr. Grant, Ogilvie, M.B., C.M.EDIN., M.O.H., *Queen Mary's House, Inverness, N.B.*

686 1892. Feb. Grantham, Richard Fuge, M.INST.C.E., *Northumberland Chambers, Northumberland Avenue, S.W.*

139 1888. Oct. Gray, Alexander, 25, *Greenhill Road, Hampstead, N.W.*

Reg. No. Date of Election.

581 1890. Apr. Greatorex, Albert Daniel, *Local Board Offices, Public Hall, Sutton, Surrey.*

718 1892. July. †Green, William Samuel, *Idridgehay, Derby.*

705 1892. Apr. Gregson, John, assoc.m.inst.c.e., *Woodbine House, Padiham, Lancaster.*

140 1888. Oct. Grellier, William, f.r.i.b.a., 6, *Queen Anne's Gate, S.W.*

335 1888. Oct. Groves, Joseph, b.a., m.d., f.g.s., *Carisbrooke, Isle of Wight.*

566 1890. Jan. Gruggen, William, d.p.h., 11, *Montpelier Road, Ealing, W.*

778 1893. July. †Haddock, Harry Frederick, 9, *Eland Road, Lavender Hill, S.W.*

620 1891. Mar. Hall, Watkin, assoc.m.inst.c.e., *Local Board Offices, College Road, Gt. Crosby, Lancashire.*

612 1891. Jan. Hamilton, Walter M., m.d., d.p.h., 456, *Liverpool Road, Patricroft, Lancashire.*

687 1892. Mar. Hampton, Willie Thomas, f.s.i., *Hotel Street, Coalville, Leicester.*

148 1888. Oct. Hancock, Charles, m.a.oxon, 2, *The Cloisters, Temple, E.C., and Reform Club, S.W.*

610 1890. Dec. Hanson, John, *Victoria Chemical Works, Wakefield.*

475 1889. Mar. Harding, J. R., m.inst.c.e., *Ashley Road, Epsom, Surrey.*

505 1889. Apr. Hare, C. J., m.d., f.r.c.p., *Berkeley House,* 15, *Manchester Square, W.*

476 1889. Mar. Harpur, William, m.inst.c.e., *Town Hall, and* 197, *Severn Road, Cardiff.*

579 1890. Apr. Harris, Arthur Wellesley, m.r.c.s., l.s.a., d.p.h., m.o.h., *High Street, Southampton.*

151 1888. Oct. Harrisson, Thomas Harnett, assoc.m.inst.c.e., f.r.i.b.a., *Central Buildings, North John Street, Liverpool.*

747 1892. Nov. Harrison, William Joseph, assoc.m.inst.c.e., f.r.met.soc., 7, *Carteret Street, Westminster, S.W.*

387 1888. Dec. Harrold, Miss C., 10, *Church Road, Edgbaston, Birmingham.*

785 1893. Oct. Harvey, Thomas Fletcher, assoc.m.inst.c.e., *Engineer and Surveyor to the Merthyr Tydfil Local Board, Merthyr Tydfil, Glamorganshire.*

648 1891. Nov. Haslam, Dryland, Junr., f.s.i., *Friar Street Chambers, Reading.*

338 1888. Oct. Haslam, Lewis, *Ravenswood, near Bolton.*

626 1891. Apr. Haslip, George Ernest, m.d., m.r.c.s., l.r.c.p., d.p.h., 3, *Southampton Street, Strand, W.C.*

152 1888. Oct. Hayward, C. F., f.s.a., f.r.i.b.a., 47, *Museum Street, Bloomsbury, W.C.*

339 1888. Oct. Head, Henry, *Buckingham, Old Shoreham, Sussex.*

418 1889. Feb. Head, Mrs. H., *Buckingham, Old Shoreham, Sussex.*

Reg. No. Date of Election.

153 1888. Oct. Hellyer, S. Stevens, 21, *Newcastle Street, Strand, W.C.*

390 1888. Dec. Hill, Miss F. M. Davenport, 7, *Upper Wimpole Street, W.*

389 1888. Dec. Hill, Miss R. Davenport, 7, *Upper Wimpole Street, W.*

423 1889. Jan. Hill, Pearson, 6, *Pembridge Square, W.*

155 1888. Oct. Hill, Samuel, A.R.I.B.A., 16, *Russell Square, W.C.*

156 1888. Oct. Hill, William H., *Town Hall, Kensington, W.*

612 1891. Oct. †Hills, Harry James, 97, *Camden Street, Camden Town, N.W.*

679 1892. Feb. Hobson, John Morrison, M.D., D.P.H., *Croydon, S.W.*

457 1889. Mar. Hodgetts, E. A. Brayley, 39, *Redcliffe Square, South Kensington, S.W., and Agence Dalziel*, 50, *Rue des Victoires, Paris.*

157 1888. Oct. Hodgson, Shadworth H., 45, *Conduit Street, W.*

638 1891. July. Hodgson, William James, ASSOC.M.INST.C.E., *High Park, Near Ryde, Isle of Wight.*

581 1890. Apr. Holberton, Henry Nelson, L.R.C.P., M.R.C.S., D.P.H., *East Moulsey, Surrey.*

158 1888. Oct. Holmes, Timothy, M.A., F.R.C.S., 18, *Great Cumberland Place, W.*

159 1888. Oct. Holt, H. P., ASSOC.M.INST.C.E., F.G.S., *The Cedars, Didsbury, Manchester.*

653 1891. Nov. Holroyde, John, M.R.C.S., L.S.A., D.P.H., M.O.H., *Camden House, Chatham.*

478 1889. Mar. Hooley, Cosmo C., ASSOC.M.INST.C.E., *The Union Offices, Barton-upon-Irwell, Manchester.*

553 1889. Nov. Hooper, Charles, M.R.C.S., M.O.H., *Aylesbury, Bucks.*

445 1889. Jan. †‡Houghton, John, *Poplar Road, King's Heath, near Birmingham.*

161 1888. Oct. Howard, E., 84, *Upper Whitecross Street, E.C.*

593 1890. June. ‡Hoy, Peter, 7, *Park Place, Clarence Gate, N.W.*

163 1888. Oct. †Hubber, Frank, 85, *South Street, Exeter.*

640 1891. Oct. †Hunt, John W., *Maindee, Newport, Monmouth.*

682 1892. Feb. Hunter, Alexander H., *Craiglands, West Kirby.*

764 1893. Feb. Hunter, John, 9, *Lincoln's Inn, W.C.*

391 1888. Dec. Inglis, Cornelius, M.D., 1, *Albert Mansions, Victoria Street, S.W.*

661 1891. Nov. Ingram, Matthew, *Hygeia Works, and Durham Lodge, Old Trafford, Manchester.*

588 1890. May. Ivor-Moore, T., *Royal Engineer's Office, Antigua, West Indies.*

605 1890. Nov. †James, Arthur Charles, ASSOC.M.INST.C.E., *Local Surveyor's Office*, 53, *High Street, Grays, Essex.*

527 1889. May. James, Charles Alfred, L.R.C.P, M.R.C.S., D.P.H., 24, *Cazenove Road, Stamford Hill, N.*

658 1891. Nov. Johnson, Samuel, M.D., C.M., M.O.H., *Stoke-on-Trent.*

702 1892. Apr. Jones, Charles, M.INST.C.E., *Local Board, Ealing, W.*

641 1891. Oct. †Kay, Walter Robert, *Mount Sion House, Bury.*

Reg. No.	Date of Election.	
502	1889. Mar.	KEMPSTER, William Henry, M.D., M.O.H., *Oak House, Battersea, S.W.*
704	1892. Apr.	KENDELL, Daniel Burton, M.B.CANTAB., *Thornhill House, Walton, Wakefield.*
168	1888. Oct.	KENNETT-BARRINGTON, SIR Vincent Hunter B., 65, *Albert Hall Mansions, Kensington Gore, W.*
675	1892. Jan.	KENWOOD, Henry R., M.B., L.R.C.P., D.P.H., F.C.S., 189, *Adelaide Road, Hampstead, N.W.*
772	1893. June.	KIDD, Thomas, ASSOC.M.INST.C.E., *City Engineer of Ripon*, 8, *Gladstone Terrace, Ripon, Yorkshire.*
717	1892. July.	†KILFORD, Henry James, *Borough Surveyor, Ilkeston, Derby.*
559	1889. Dec.	KIRBY, Oscar John, *Kelvin Grove, Staincliffe, Dewsbury.*
759	1893. Feb.	†‡KIRK, John Wright, *Town Hall, Caxton Street, Westminster, S.W.*
501	1889. Mar.	KIRWAN, SURG.-LT.-COL. A., D.P.H., F.R.C.S.EDIN., 10, *Wenlock Terrace, York.*
479	1889. Mar.	KYLE, Thomas W., M.D., D.P.H., M.O.H., *Measham, Atherstone.*
174	1888. Oct.	LACY, William George, 82, *East Hill, Wandsworth, S.W.*
710	1892. May.	LAFFAN, George Bastable, ASSOC.M.INST.C.E., *Local Board Offices, Queen's Road, Twickenham.*
534	1889. May.	LAING, R., M.R.C.S., L.R.C.P., F.R.MET.SOC., M.O.H., 29, *Waterloo Road, Blyth, Northumberland.*
779	1893. July.	LAKE, W. Wellington, M.R.C.S.(ENG.), D.P.H.(CAMB.), *Medical Officer of Health, Broad Street Common, near Guildford.*
775	1893. July.	†LAMBERT, Joshua, *Local Board Offices, Tottenham, N.*
393	1888. Dec.	LAVENDER, Charles Henry Nalder, 72, *St. Ermin's Mansions, Westminster, S.W.*
748	1892. Nov.	LAW, Herbert Henry, ASSOC.M.INST.C.E., 17, *Victoria Street, S.W.*
693	1892. Mar.	LAWFORD, George Maxwell, ASSOC.M.INST.C.E., M.SOC.E., 13, *Victoria Street, S.W.*
175	1888. Oct.	LAWRENCE, Edwin, 10, *Kensington Palace Gardens, W.*
753	1893. Jan.	LAW-GREEN, Charles, ASSOC.M.INST.C.E., *Surveyor, Swindon Highway Board, Swindon, Wilts, and Oundle, Northampton.*
177	1888. Oct.	LE GRAND, A., 125, *Bunhill Row, E.C.*
179	1888. Oct.	LEONARD, Hugh, 7, *Hanover Square, W.*
180	1888. Oct.	LE ROSSIGNOL, Francis, F.S.I., 1, *Gresham Buildings, Basinghall Street, E.C.*, (29, *Penn Road Villas, Camden Road, N.*).
536	1889. June.	LETTS, Thomas Hollins, 185, *Earls Court Road, South Kensington, S.W.*
742	1892. Oct.	LEWIS, Thomas Laurence, *Engineer and Surveyor, St. George, Gloucester.*

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182 1888. Oct. Lingard, J. Edward, *Rodney Chambers, Derby.*

673 1892. Jan. Little, John Fletcher, M.B., M.R.C.P., M.O.H., 32, *Harley Street, Cavendish Square, W.*

768 1893. May. Livingstone, George, Assoc.M.Inst.C.E., *Surveyor to the Vestry of St. George's, Hanover Square,* 1, *Pimlico Road, London, S.W.*

767 1893. May. †‡Lloyd, Christopher, 2, *St. Mark's Terrace, New Brompton, Kent.*

183 1888. Oct. Lloyd, Robt. Samuel, 84 & 85, *Whitecross St., E.C.*

575 1890. Mar. Loane, Joseph, M.R.C.P.E., D.P.H., M.O.H., 98, *Tressillian Road, St. John's, S.E.*

507 1889. Apr. Lockwood, Phillip Causton, M.Inst.C.E., 1, *Gloucester Place, Brighton, Sussex.*

700 1892. Apr. Lowe, Louis J. McKenzie, M.Inst.C.E., *Cassilla de Correo* 665, *Buenos Ayres, Argentine Republic, South America.*

425 1889. Jan. Lowe, Mrs. Thomas, *Solihull, Birmingham.*

632 1891. June. Lynde, Frederick Charles, Assoc.M.Inst.C.E., 25, *Cross Street, Manchester,* (9, *Victoria Street, S.W.*).

185 1888. Oct. Lyon, Washington, 85, *Asylum Road, Peckham, S.E.*

190 1888. Oct. ‡Mackenzie, F. Morell, M.R.C.S., L.S.A., 10, *Hans Place, S.W.*

656 1891. Nov. Mackenzie, William Leslie, M.A., M.B., C.M., D.P.H., County M.O.H., *Castle Douglas, N.B.*

191 1888. Oct. Mackey, John B., 2, *Bouverie Street, Fleet Street, E.C.*

458 1889. Mar. Macnamara, Charles Edward, L.K.Q.C.P.I., D.P.H., 95, *Stephen's Green, Dublin.*

396 1888. Dec. McArthur, A., J.P., D.L., 79, *Holland Park, W.*

600 1890. Oct. McBeath, William, M.A., M.D., D.P.H., 7, *Flora Place, Plymouth.*

198 1888. Oct. McIntosh, James, *Duneevan, Oatlands Park, Weybridge.*

342 1888. Oct. McKie, Hugh Umsworth, M.Inst.C.E., 11, *Victoria Street, Westminster, S.W.*

199 1888. Oct. McMorran, Alexander, *Galloway House, Carlton Road, Putney, S.W.*

580 1890. Apr. McNeill, Roger, M.D., D.P.H., J.P. *Argyllshire, County Medical and Sanitary Officer, Oban.*

193 1888. Oct. †Maguire, William Robert, F.R.Met.Soc., 10, *Dawson Street, Dublin,* (*Town Hill, Dalkey, Co. Dublin*).

194 1888. Oct. Maltby, Frederic Thomas, Assoc.M.Inst.C.E., *Surveyor's Office, Guildford.*

672 1892. Jan. Manley, Herbert, M.A., M.B., D.P.H., M.O.H., *West Bromwich.*

594 1890. July. Marsden, James Aspinall, M.R.C.S., L.S.A., D.P.H., M.O.H., *Standish, Wigan, Lancashire.*

736 1892. Oct. Marsden, Robert Sidney, M.B., D.Sc., F.R.S.E., M.O.H., 65, *Grange Mount, and Town Hall, Birkenhead.*

Reg. No. Date of Election.

412 1888. Dec. Martindale, William, 10, *New Cavendish Street, W.*

195 1888. Oct. Martineau, E. H., F.R.I.B.A., 30, *Weymouth Street, Portland Place, W.*

770 1893. May. Mason, Charles, ASSOC.M.INST.CE., A.R.I.B.A., MEM.SOC.ENG., *Surveyor to the Vestry of St. Martin's-in-the-Fields, The Town Hall, Charing Cross, London, S.W.*

196 1888. Oct. Mason, Hugh H., M.R.C.S., *Abbey Lodge, Barking.*

684 1892. Feb. Massie, Frank, ASSOC.M.INST.C.E., F.S.I., F.R.MET.SOC., *Tetley House, Wakefield.*

769 1893. May. Mathews, George Somers, ASSOC.M.INST.C.E., *Surveyor to the Local Board, Dorking, 35, High Street, Dorking, Surrey.*

197 1888. Oct. Mathews, J. Douglass, F.R.I.B.A., F.S.I., 11, *Dowgate Hill, E.C.*

343 1888. Oct. Melissenos, G. C. A. Melisurgo, ASSOC.M.INST.C.E., *Palazzo Cocozzo, 76, Via Poerio, Naples.*

201 1888. Oct. †Metcalf, John W., ASSOC.M.INST.C.E., *Surveyor, Town Hall, Newmarket.*

204 1888. Oct. Mineard, George Edward, F.R.H.S., 70, *Philbeach Gardens, Earl's Court, S.W.*

738 1892. Oct. †Mitchell, Lewis, *Hurlford, Kilmarnock, N.B.*

663 1891. Dec. Mitchell, Robert, *Consulting Sanitary Engineer, Cape Town, South Africa.*

205 1888. Oct. Mocatta, F. D., 9, *Connaught Place, W.*

207 1888. Oct. Montagu, Samuel, 12, *Kensington Palace Gardens, W.*

668 1891. Dec. More, James, Jun., ASSOC.M.INST.C.E., F.R.MET.SOC., 49, *Orlando Road, Clapham, S.W.*

628 1891. May. Morgan, William Barlow, ASSOC. M. INST. C. E., *Surveyor, Weymouth.*

542 1889. July. Morison, John, M.D., D.P.H., *Victoria Street, St. Albans.*

643 1891. Oct. †Morley, Edwin, *Town Hall, Walthamstow.*

208 1888. Oct. †Morley, J. G., ASSOC.M.INST.C.E., *Town Hall, Stratford, E.*

615 1891. Jan. Morris, Albert, M.R.C.S., L.R.C.P., *Post Office Buildings, Southend.*

750 1892. Nov. ‡Morris, Griffith John, *R.E. Establishment, Barbadoes.*

528 1889. May. Morris, Pryce Jones Langford, M.R.C.S., L.R.C.P., M.O.H., *Halesworth, Suffolk.*

210 1888. Oct. Mouat, F. J., M.D., 12, *Durham Villas, Kensington, W.*

211 1888. Oct. Mouat, Surgeon-General J., C.B., F.R.C.S., 108, *Palace Gardens Terrace, W.*

213 1888. Oct. Mumby, B. H., M.D., D.P.H., M.R.C.S., M.O.H., *Town Hall, Portsmouth.*

512 1889. Apr. Munce, James, ASSOC.M.INST.C.E., *Town Hall, Belfast.*

Reg. No. Date of Election.

563 1889. Dec. MUNDAY, MAJOR Henry, 23, *Oakley Square, N.W.*
215 1888. Oct. NANSON, Tom, 9, *Park Crescent, Stockwell Park Road, S.W.*
362 1888. Nov. NASH, BRIGADE-SURGEON William, M.D., 18, *Victoria Street, Westminster, S.W.*
529 1889. May. NASMYTH, Thomas Goodall, M.D., D.SC., M.O.H., *County Buildings, Cupar, Fife, N.B.*
216 1888. Oct. NELSON, George H., *The Lawn, Warwick.*
733 1892. Oct. †‡NEWMAN, Reginald William, ASSOC.M.INST C.E., 3, *Kempton Villas, Hampton, Middlesex.*
220 1888. Oct. †NICHOLS, H. Bertram, ASSOC.M.INST.C.E., *Grosvenor Chambers, Corporation Street, Birmingham.*
219 1888. Oct. NICOL, W. E., *Ballogie, Aboyne, Aberdeen, N.B.*
609 1890. Dec. NUNN, F. C., ASSOC.M.INST.C.E., *Eastnor, Sydenham Hill, S.E.*
757 1893. Jan. O'NEILL, Henry, M.D., M.CH., 6, *College Square E., Belfast.*
228 1888. Oct. PAGE, Herbert Markant, M.D., D.P.H.CAMB., M.R.C.S., 16, *Prospect Hill, Redditch.*
230 1888. Oct. PAGLIARDINI, T., 21, *Alexander Street, Westbourne Park, W.*
531 1889. May. PARKER, G. R., M.R.C.S., L.R.C.P., M.O.H., 34, *King Street, Lancaster.*
503 1889. Mar. PARKER, John, ASSOC.M.INST.C.E., 42, *Dryden Street, Nottingham.*
578 1890. Mar. †PARKER, John, ASSOC.M.INST.C.E., *City Engineer, Hereford.*
720 1892. July. PARKER, John Edward, ASSOC.M.INST.C.E., *Surveyor and Sanitary Inspector, Lanchester, Durham.*
716 1892. July. PARKIN, John Robert, ASSOC.M.INST.C.E., *Idridgehay, Derby.*
780 1893. July. PARNACOTT, Alfred, F.S.I., 93, *York Road, Westminster Bridge Road, S.W.*
233 1888. Oct. PARSONS, H. Franklin, M.D., *Local Government Board, Whitehall, S.W.*
481 1889. Mar. PARTRIDGE, Thomas, M.R.C.P.I., M.R.C.S.E., L.S.A., M.O.H., *Stroud, Gloucester.*
722 1892. Sept. PASTEUR, William, M.D., F.R.C.P., 4, *Chandos Street, Cavendish Square, W.*
530 1889. May. PATTEN, Charles Arthur, L.R.C.P., M.O.H., *Ealing, W.*
234 1888. Oct. PATTINSON, S., *Ruskington, Sleaford, Lincoln.*
399 1888. Dec. PEAKE, Francis, *The Waldrons, Croydon, S.W.*
400 1888. Dec. PEEL, Edmund, *Brynfys, Ruabon, North Wales.*
781 1893. July. †PHELPS, William, 38, *Wingate Road, Hammersmith, W.*
236 1888. Oct. †PHILLIPSON, Burton R., *Baggot Street, Dublin.*
660 1891. Nov. PILLEY, John J., *Crescent Lodge, Camberwell Grove, S.E.*
749 1892. Nov. PLATT, Samuel Sydney, ASSOC.M.INST.C.E., *Borough Surveyor, Town Hall, Rochdale.*

Reg. No. | Date of Election.

751 1892. Dec. ‡Poulson, Frederick Thomas, *County Sanitary Inspector*, 58, *Wolverhampton Road, Stafford.*

237 1888. Oct. Powell, George Thompson, *Rotherwood, Sydenham Hill, S.E.*, (28 *and* 29, *St. Swithin's Lane, E.C.*).

344 1888. Oct. Powell, J., 19, *Castle Street, Liverpool.*

402 1888. Dec. Priestley, Lady Eliza, 17, *Hertford Street, Mayfair, W.*

345 1888. Oct. Pritchett, G. E., F.S.A., F.R.I.B.A., *Oak Hall, Bishop's Stortford*, (1, *Hanway Place, Oxford Street, W.*).

238 1888. Oct. Pullar, Robert, J.P., F.R.S.E., *Tayside, Perth, N.B.*

240 1888. Oct. Purnell, W. J., *Vincent Row, Vincent Street, Westminster, S.W.*

241 1888. Oct. Purnell, E. W., *Vincent Row, Vincent Street, S.W.*

243 1888. Oct. Quain, Sir R., Bart., M.D., F.R.S., 67, *Harley Street, W.*

550 1889. Nov. †‡Radcliffe, Joseph, F.R.MET.SOC., *The Waterworks, Todmorden.*

604 1890. Nov. Radford, John Charles, ASSOC.M.INST.C.E., *Surveyor*, 153, *High Street, Putney, S.W.*

249 1888. Oct. †Radford, W. H., ASSOC.M.INST.C.E., A.R.I.B.A., *Pelham Chambers, Angel Row, Nottingham.*

482 1889. Mar. †Railton, James, *East Barnet Valley Local Board, Station Road, New Barnet.*

586 1890. Apr. Rainger, Charles Henry, 9, *Bath Place, Cheltenham.*

483 1889. Mar. Read, Richard, ASSOC.M.INST.C.E., *City Surveyor, Gloucester.*

741 1892. Oct. Redman, Robert Wilkins, *Borough Surveyor, Deal, Kent.*

363 1888. Nov. Reynolds, Mrs. Russell, 38, *Grosvenor Street, W.*

574 1890. Mar. Rhodes, John William, 7, *Mitre Court Chambers, Temple, E.C.*

707 1892. Apr. Richardson, William, M.D., B.SC.P.H., *Lunatic Asylum, Union Mills, Isle of Man.*

760 1893. Feb. Richmond, John, *Architect*, 7, *Great College Street, Westminster, S.W.*

740 1892. Oct. †Ridgway, Ernest Reginald, *Long Eaton, Derby.*

251 1888. Oct. Ridings, H. Sadleir, M.A., M.INST.C.E., *Care of H. S. King & Co.*, 65, *Cornhill, E.C.*

253 1888. Oct. Roberts, Frederick F., M.D., 102, *Harley Street, W.*

571 1890. Jan. Roberts, Richard Lawton, M.D., D.P.H.CAMB., M.R.C.S., L.S.A., *Ruabon, North Wales.*

403 1888. Dec. Robins, Edward, 22, *Conduit Street, W.*

703 1892. Apr. Robinson, James, ASSOC.M.INST.C.E., *County Surveyor, Winchester, Hants.*

404 1888. Dec. Roe, Surgeon-Major, E. A. H., 17, *Whitehall Place, S.W.*

515 1889. Apr. Rogers, George Arthur, M.R.C.S.E., L.S.A., M.O.H., 404, *Commercial Road, E.*

Reg. No. Date of Election.

735 1892. Oct. Ross, Percival, ASSOC.M.INST.C.E., *Surveyor to North Bierley Local Board, Bradford.*

255 1888. Oct. RUSSELL, HON. LADY Agatha, *Pembroke Lodge, Richmond Park, Surrey.*

649 1891. Nov. †SAISE, Alfred John, *Stapleton, Bristol.*

484 1889. Mar. SANDELL, Henry W. Adrian, M.R.C.S., M.O.H., *Leighton Buzzard.*

681 1892. Feb. SANDERS, Henry Ingalton, *St. Regulus, Archers Road, Southampton.*

657 1891. Nov. SCOTT, Conway, B.E., *Executive Sanitary Officer, Town Hall, Belfast.*

486 1889. Mar. SCOTT, Hugh Hamilton, ASSOC.M.INST.C.E., *Town Hall, Hove, Brighton.*

263 1888. Oct. SCOTT-MONCRIEFF, W. D., M.I.M.E., 86, *Newman Street, W.*

739 1892. Oct. SCOTT, Robert Smith, ASSOC.M.INST.C.E., *Town Surveyor, Bishop Stortford.*

786 1893. Oct. †SCOTT, Thomas Keat, *Town Surveyor*, 3, *Albion Terrace, Whitby, Yorkshire.*

264 1888. Oct. SCRIVEN, J. Barclay, M.R.C.S., 95, *Oxford Gardens, North Kensington, W.*

414 1888. Dec. SEARLES-WOOD, Herbert D., F.R.I.B.A., 157, *Wool Exchange, E.C.*

429 1889. Jan. SELBY, Prideaux, *Koroit, North Park, Croydon, S.W.*

487 1889. Mar. SELLERS, William, Junr., M.D., M.O.H., *Bank House, Radcliffe, Manchester.*

488 1889. Mar. SHADWELL, St. Clair B., L.R.C.P., M.R.C.S., M.O.H., *Lynhurst, Walthamstow.*

489 1889. Mar. SHAW, Charles Knox, L.R.C.P., M.R.C.S., 19, *Upper Wimpole Street, W.*

524 1889. Apr. SHAW, Josephus, M.R.C.S., L.S.A., M.O.H., 151, *Lower Road, Rotherhithe, S.E.*

644 1891. Oct. SHELBOURN, Michael, *Architect and Surveyor, Belvoir, Grantham.*

659 1891. Nov. SHIMELD, James, L.R.C.P. and S.E., M.O.H., *Salisbury House, Ilford.*

430 1889. Jan. SHONE, Isaac, ASSOC.M.INST.C.E., 47, *Victoria Street, Westminster, S.W.*

266 1888. Oct. SHONKSMITH, John Henry, *Micklegate, York.*

267 1888. Oct. SILLAR, W. C., *St. James' Lodge, Kidbrooke Park Road, Blackheath, S.E.*

411 1888. Dec. SIMPSON, William John, M.D., D.P.H.CAMB., *Health Officer, Calcutta.*

269 1888. Oct. SIORDET, James Lewis, M.B., F.R.C.P., *Villa Cabrolles, Mentone, Alpes-Maritimes, France.*

270 1888. Oct. SKRINE, Henry Duncan, *Claverton Manor, Bath.*

539 1889. June. †‡SMITH, Charles Chambers, *Surveyor's Office, Dalton-in-Furness.*

697 1892. Mar. SMITH, John, ASSOC.M.INST.C.E., *County Surveyor's Office, Ballinasloe, Galway.*

Reg. No.	Date of Election.	
271	1888. Oct.	SMITH, Percival Gordon, F.R.I.B.A., *Highfield, Stonebridge Park, Willesden.*
272	1888. Oct.	SMITH, R. Wagstaff, *Mount Rundell, Harborne, Birmingham.*
273	1888. Oct.	SMITH, Thos. Fredk. H., F.R.C.S., L.S.A., *Farningham, Kent.*
449	1889. Feb.	SMITH, T. V., 111, *Grosvenor Road, S.W.*
727	1892. Sept.	SMITH, Urban A., ASSOC.M.INST.C.E., 2, *Victoria Mansions, Westminster, S.W.*
431	1889. Jan.	SNELL, Alfred, W., A.R.I.B.A., 1, *Park Road, Wimbledon, S.W.*
794	1893. Dec.	SOUTH, Andrew, *Surveyor, Carnbrae, Hamilton Road, Ealing, W.*
513	1889. Apr.	SOUTHAM, Arthur, ASSOC.M.INST.C.E., 60, *Old Town, Clapham, S.W.*
787	1893. Oct.	†‡SPINK, Joseph, *Formby, Liverpool.*
723	1892. Sept.	†STANBURY, W. H., *Royal Engineer's Office, Gibraltar.*
275	1888. Oct.	STANSFIELD-BRUN, J., F.R.I.B.A., *Civil Engineer and Architect, Mumbles, Swansea.*
521	1889. Apr.	STEEL, William D., M.D., M.O.H., D.P.H., *Neville Street, Abergavenny.*
493	1889. Mar.	STEEVES, George Walter, B.A., M.D., M.O.H., 53, *Parkfield Road, Liverpool.*
276	1888. Oct.	STEPHENSON, J. Gurdon L., ASSOC.M.INST.C.E., M.I.M.E., F.G.S., 6, *Drapers Gardens, E.C.*, (14, *Maxilla Gardens, Notting Hill, W.*).
602	1890. Oct.	STEVENS, Joseph Wallace, *Belph, Whitwell, near Chesterfield.*
277	1888. Oct.	STEVENSON, Thomas, M.D., 45, *Gresham Road, S.W.*
494	1889. Mar.	STEWART, Alan, *Maldon, Essex.*
433	1889. Jan.	STIFF, Ebenezer, *London Pottery, Lambeth, S.W.*
279	1888. Oct.	STREET, William C., A.R.I.B.A., ASSOC.INST.C.E., 7, *Victoria Street, Westminster, S.W.*
439	1889. Jan.	†SWAINSON, John Henry, M.S.A., ASSOC.M.INST.C.E., 3A, *High Street, Wrexham, N. Wales.*
438	1889. Jan.	†SWAN, Harold, 114, *Trinity Road, Upper Tooting.*
406	1888. Dec.	SWINBURNE, C. A., *Belgrave Mansions, Grosvenor Gardens, S.W.*
667	1891. Dec.	SWINNERTON, Robert Allen William, ASSOC.M.INST.C.E., M.I.M.E., *Bolarum, Dekkan, India.*
495	1889. Mar.	SYKES, Matthew Carrington, L.R.C.P., M.R.C.S., D.P.H., *Barnsley.*
281	1888. Oct.	†TATTERSALL, W., 90, *Arden Terrace, Accrington.*
287	1888. Oct.	TAYLOR, Charles, M.R.C.S., L.S.A., 3, *Lorraine Road, Holloway, N.*
788	1893. Oct.	TAYLOR, Michael Henry, L.R.C.P., L.R.C.S.EDIN., D.P.H.CAMB., 16, *Church Road, Richmond, Surrey.*
434	1889. Jan.	TAYLOR, Wm. Fredk., M.D., M.R.C.S., L.S.A., D.P.H., *Ontario, Edward Street, Brisbane, Queensland.*

Reg. No. Date of Election.

288 1888. Oct. TEALE, T. Pridgin, M.A., M.B., F.R.C.S., F.R.S., 38, *Cookridge Street, Leeds.*

795 1893. Dec. TEW, James Scott, M.D., D.P.H., M.O.H., 22, *Burns Street, Nottingham.*

729 1892. Oct. THOMAS, John, ASSOC.M.INST.C.E., *Engineer Swansea R.S.A.*, 14, *Finsbury Terrace, Swansea.*

289 1888. Oct. THOMAS, Walter, ASSOC.M.INST.C.E., *Castleknowie, and Town Hall, Dover.*

290 1888. Oct. †THOMAS, W. E. C., ASSOC.M.INST.C.E., *Cringallt, Neath.*

454 1889. Feb. THOMPSON, Thomas William, L.R.C.P., M.R.C.S., D.P.H., *Med. Inspector, Local Government Board, S.W.*

790 1893. Oct. THOMPSON, John Henry, M.O.H., *Mytholmroyd, Yorkshire.*

592 1890. June. †THOMSON, Gilbert, 75, *Bath Street, Glasgow.*

349 1888. Oct. THORNEYCROFT, LIEUT.-COL., *Tettenhall Towers, Wolverhampton.*

570 1890. Jan. THRESH, John Clough, M.B., B.S., D.SC., F.I.C., F.C.S., M.O.H., *Chelmsford.*

435 1889. Jan. THRING, RIGHT HON. LORD, K.C.B., F.R.G.S., 5, *Queen's Gate Gardens, S.W.*

543 1889. July. THURSFIELD, W. N., M.D., D.P.H., M.O.H., *Shrewsbury.*

793 1893. Nov. †TIGHE, Michael J., 8, *Upper Sherrard Street, Dublin.*

407 1888. Dec. TITMAS, William, 34, *Grafton Street, W.C.*

789 1893. Oct. †TOWLSON, Samuel, *Surveyor to the Cheshunt Local Board, Cheshunt, Herts.*

685 1892. Feb. ‡TOWNSEND, John Walter, *Wendreda, Lancaster Road, Wimbledon, S.W.*

293 1888. Oct. TRAVERS, William, M.D., F.R.C.S., 2, *Phillimore Gardens, W.*

408 1888. Dec. TREW, J. Fletcher, 12, *Clarence Street, Gloucester*, (22, *Broad Street, Bristol*).

761 1893. Feb. ‡TROW, Samuel, *Engineer and Surveyor to the Otley Local Board, Otley, Yorkshire.*

763 1893. Feb. TURNER, Rev. Samuel William, *Little Ellingham, Norfolk.*

348 1888. Oct. TYNDALE, Walter Clifford, ASSOC.M.INST.C.E., *Horse Guards, Whitehall, S.W.*, (*St. Stephen's Road, Ealing, W.*).

496 1889. Mar. UNDERHILL, A. S., M.B., B.A., M.R.C.S., D.P.H., *Great Bridge, Tipton*

773 1893. June. UNSWORTH, William, ASSOC.M.INST.C.E., *Assistant-Surveyor to the Toxteth Park Local Board*, 16, *Wendover Avenue, Aigburth Road, Liverpool.*

294 1888. Oct. VALON, William A., ASSOC.M.INST.C.E., 140, *Temple Chambers, Temple Avenue, E.C.*

689 1892. Mar. VERDON, H. Walter, M.D., F.R.C.S., M.O.H., 47, *Brixton Hill, S.W.*

Reg. No. Date of Election.

303 1888. Oct. Wallace, William, 27a, *Old Bond Street, W.*

596 1890. Oct. †‡Wallis, Arthur Gray, *Care of West of Scotland Sanitary Association*, 75, *St. George's Place, Glasgow.*

304 1888. Oct. Wallis, H. Sowerby, F.R.MET.SOC., 25, *Northwood Road, Highgate, N.*

585 1890. Apr. Wallis, Isabel White, 49, *Clifton Hill, St. John's Wood, N.W.*

706 1892. Apr. Walton, Rienzi G., M.INST.C.E., 2, *Lexham Gardens, Kensington, S.W.*

647 1891. Nov. Ward, Arthur W., ASSOC.M.INST.C.E., *Lisburn, Merton Road, Southsea.*

437 1889. Jan. Welch, Henry, M.D., B.SC., D.P.H.EDIN., *Shefferlands, Halton, Lancaster.*

364 1888. Nov. Wells, Sir T. Spencer, Bart., M.D., F.R.C.S., 3, *Upper Grosvenor Street, W.*

744 1892. Nov. Wetwan, William Albert, M.R.C.S., L.S.A., *Medical Officer of Health for Bridlington*, 17, *The Promenade, Bridlington Quay, Yorkshire (East Riding).*

655 1891. Nov. Whitaker, William, B.A., F.R.S., F.G.S., ASSOC.M.INST. C.E., 33, *East Park Terrace, Southampton*, (28, *Jermyn Street, S.W.*).

409 1888. Dec. †Whitcombe, Arthur, 48 *&* 50, *Howland Street, Fitzroy Square, W.*

771 1893. May. White, John, ASSOC.M.INST.C.E., *Borough Surveyor*, 29, *Dover Road, Folkestone, Kent.*

305 1888. Oct. White, William, F.S.A., F.R.I.B.A., 30*a*, *Wimpole Street, W.*

509 1889. Apr. Wightwick, Fallon Percy, M.B., M.R.C.S., L.R.C.P., D.P.H., 5, *Curlew Street, Horsleydown, S.E.*

306 1888. Oct. Wilkinson, W. B., *Northumberland Street, Newcastle-on-Tyne.*

307 1888. Oct. ‡Wilkinson, William, *Town Hall, Salford*, (21, *Park Place, Cross Lane, Salford*).

308 1888. Oct. Williams, C. Theodore, M.A., M.D., F.R.C.P., F.R.MET. SOC., 2, *Upper Brook Street, W.*

715 1892. June. Williams, Owen, *Surveyor, Aberdare, Glamorgan.*

670 1891. Dec. Williams, Roscoe A., M.D., *State Board of Health, Olathe, Kansas, U.S.A.*

562 1889. Dec. Williams, William, M.A., M.B., D.P.H.OXON, M.R.C.S., L.S.A., *Glamorgan County Office, Westgate Street, Cardiff.*

734 1892. Oct. †Williams, William Iltyd, 4, *Norton Road, West Brighton.*

523 1889. Apr. Willis, George, L.F.P.S.G., M.O.H., *Clifton House, Baillieston, Glasgow.*

712 1892. June. Willis, John, *Stansfield, Clewer, Windsor.*

309 1888. Oct. †Wilson, J. B., *Court House, Cockermouth.*

737 1892. Oct. †Wilson, John Allen, 18, *Rodney Terrace, Cheltenham.*

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310 1888. Oct. Withers, J. B. Mitchell, F.R.I.B.A., 73, *Surrey Street, Sheffield.*

311 1888. Oct. †‡Witts, J. W., M.S.E., *Borough Engineer's Office, Leeds.*

312 1888. Oct. Wood, Jacob, 186, *Highbury New Park, N.*

365 1888. Nov. Wood, William, M.D., 99, *Harley Street, W.*

497 1889. Mar. Woodman, John, M.D., F.R.C.S., M.O.H., *Southernhay, Exeter.*

313 1888. Oct. Woodward, Edward Francis, 43, *Southwell Street, Bristol.*

776 1893. July. †‡Worrall, Ernest, 5, *Beaconsfield Terrace, Seacombe, Liverpool.*

444 1889. Jan. †Worth, John Edward, M.INST.C.E., F.R.MET.SOC., *District Engineer, London County Council, Spring Gardens, S.W.*

314 1888. Oct. Wyndham, Rev. Francis M., M.A.OXON, *St. Mary of the Angels, Westmoreland Road, Bayswater, W.*

315 1888. Oct. Yuill, W., ASSOC.M.INST.C.E., 3, *Fenchurch Avenue, E.C.*

ASSOCIATES (Assoc. San. Inst.)

‡ Marked thus have passed the Examination of the Institute for Inspectors of Nuisances.

1 1888. Oct. ‡Abrams, Henry, *Sanitary Inspector, Bexley, Kent.*

630 1892. Sept. ‡Ackernley, Joseph, *Broughton Road, Skipton, York.*

212 1889. Nov. ‡Adams, Albert E., *Local Board Offices, Town Hall, Wood Green, N.*

2 1888. Oct. ‡Adams, H. J., 13, *Salcott Road, Wandsworth Common S.W.*

51 1888. Oct. Adams, Miss Rose (Ladies' Sanitary Association), 22, *Berners Street, Oxford Street, W.*

756 1893. June. ‡Allan, George Awburn, Junr., 5, *Clipstone Street, Great Portland Street, W.*

658 1892. Nov. ‡Allen, Thomas Holtan, *Stumpshaw, Norfolk.*

137 1889. Jan. ‡Allen, William Henry, 8, *St. John's Square, Cardiff.*

337 1890. Nov. ‡Amor, Alfred, *Octagon Chambers, Nelson Street, Bath.*

4 1888. Oct. ‡Amor, Daniel C., *Beaulieu, The Polygon, Southampton.*

646 1892. Oct. ‡Anderson, George Hart, 33, *Borough Road West, Middlesborough.*

528 1892. Feb. ‡Andrews, Daniel James, *Court House, Marylebone, W.*, (97, *Hall Place, Paddington, W.).*

314 1890. July. Annett, William Fenn, 5, *Church Street, Kensington, W.*

Reg. No. Date of Election.

501 1892. Feb. ‡Anthony, Frederick Joseph, 33, *Yattan St., Bromley, E.*

636 1892. Sept. ‡Armitage, Frederick Lincoln, 126, *South Street, Huddersfield.*

637 1892. Sept. ‡Armitage, T. Albert, *South Parade, Huddersfield, Yorkshire.*

826 1893. Dec. ‡Armstrong, Joseph, 3, *Colvestone Crescent, Kingsland, N.E.*

389 1891. Apr. ‡Ashdown, Thomas, *Vestry Hall, St. Olaves, Southwark, S.E.*

732 1893. May. ‡Ashfield, Ralph, 5, *Lansdowne Street, Worcester.*

698 1893. Feb. ‡Ashley, Sydney, 14, *Gower Street, Bedford Square, W.C.*

714 1893. Apr. ‡Ashurst, George Norman, 40, *Allington Street, St. Michael's, Liverpool.*

525 1892. Feb. ‡Athey, Frederick, 47, *Penge Road, South Norwood, S.E.*

609 1892. June. ‡Atkins, Benjamin, 31, *Russell Street, Leamington Spa.*

567 1892. May. ‡Atkins, Robert William, 32, *Holmwood Road, South Norwood, S.E.*

584 1892. May. Atkinson, Thomas Appleton, *Sanitary Inspector, Darlington.*

607 1892. June. Attridge, Henry L., *Sanitary Engineer, Firmont Road, Sea Point, Cape Town, South Africa.*

505 1892. Feb. ‡Ayliffe, Charles William Loveless, 19, *Brompton Road, S.W.*

200 1889. July. ‡Bailey, William, 76, *Wilmslow Road, Withington, Manchester.*

181 1889. June. ‡Bainton, John, *Sanitary Office, Scunthorpe, Doncaster.*

168 1889. Apr. Baker, William, mem. soc. arts, 1, *Chetwynd Road, Lawrence Road, Southsea.*

635 1892. Sept. ‡Baldwin, Parkinson, 16, *Montana Sireet, Higher Openshaw, Manchester.*

211 1890. Feb. ‡Balster, Herbert, *Town Hall, Margate.*

5 1888. Oct. Bamlett, Adam Carlisle, *Thirsk, Yorkshire.*

106 1889. Jan. ‡Barfoot, James, 100, *Brook Street, Kennington Road, Lambeth, S.E.*

757 1893. June. ‡Barralet, Thomas Chapman, *Surveyor and Inspector, Godstone.*

780 1893. July. ‡Barrett, Henry James, 20, *Gowan Avenue, Fulham, S.W.*

6 1888. Oct. ‡Barron, John, 33, *Landor Road, Stockwell, S.W.*

719 1893. Apr. ‡Barth, Frederick Alfred, *St. Luke's Vestry Hall, City Road, E.C.*

357 1891. Feb. ‡Bartlett, William John, 50, *Cumming Street, E.C.*

7 1888. Oct. ‡Bascombe, H. C., *Wallasey Local Board, Egremont, Cheshire.*

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195	1889. June.	‡Bassett, William Joshua, 16, *Elizabeth Street, Eaton Square, S.W.*
608	1892. June.	‡Bates, Matthew, *Local Board Offices, Bromley, Kent.*
265	1890. Apr.	‡Baxter, Frank E., 374, *Kennington Road, S.E.*
9	1888. Oct.	‡Baxter, John, 374, *Kennington Road, S.E.*
806	1893. Nov.	‡Bedford, Edward, *Chapel Allerton, Leeds, Yorkshire.*
479	1891. Dec.	‡Beech, James, *Ivy Cottage, Brownhills, Tunstall.*
781	1893. July.	‡Bennett, Edward, 43, *Manor Park Road, Harlesden, N.W.*
182	1889. June.	‡Birch, John Ernest William, 107, *Cobden Road, South Norwood, S.E.*
493	1892. Jan.	Bird, Sidney James, *H. M. Convict Prison, Portland, Dorset.*
287	1890. May.	‡Bird, William Frederick, *The Island, Midsomer Norton.*
313	1890. July.	‡Bishop, William F., *Margam Local Board, Taibach, Port Talbot.*
10	1888. Oct.	‡Black, Andrew E., 16, *Bank Street, Inverness, N.B.*
404	1891. May.	‡Blackman, Henry, *Catsfield, Battle.*
99	1888. Dec.	Blake, E. T., M.D., 64, *Seymour St., Hyde Park, W.*
375	1891. Mar.	‡Blake, H. K., 1, *Victoria Road, Stroud Green, N.*
193	1889. June.	Bland, William, 420, *Liverpool Road, Patricroft.*
758	1893. June.	‡Blay, Ernest Berringer, 116, *Matthias Road, Stoke Newington, N.*
631	1892. Sept.	‡Bolton, Joseph, 15, *Cambridge Terrace, Otley, York.*
777	1893. June.	‡Bone, William Homersham, 35, *Mall Road, Hammersmith, W.*
12	1888. Oct.	‡Bostel, G. Stanford, 18, *Duke Street, Brighton.*
392	1891. Apr.	‡Bourne, Edward, 256, *High Street, Cheltenham.*
208	1889. July.	‡Bowyer, Harry David, *Park Street, Slough.*
13	1888. Oct.	‡Boyce, W., 117, *High Street, Poplar, E.*
14	1888. Oct.	Boyd, Richard Wade, 105, *New Bond Street, W.*
382	1891. Mar.	‡Braley, Francis, 18, *Woodbine Avenue, Leicester.*
610	1892. June.	‡Bramham, William, *Fern Cottage, Market Street, Clay Cross.*
15	1888. Oct.	Breeze, John, *Poynton Lodge, Wellington, Salop.*
767	1893. June.	‡Bridel, H. F., 3, *Ballast Quay, East Greenwich, S.E.*
769	1893. June.	‡Bridges, Oswald Arthur, *Engineer and Surveyor's Office, Lymington, Hants.*
808	1893. Nov.	‡Brierley, Samuel, 26, *Elford Grove, Roundhay Road, Leeds.*
16	1888. Oct.	Broad, Clement B., *Stamford Brook Lodge, Ravenscourt Park, W.*
334	1890. Nov.	‡Brook, John, *Albany Place, Stratford-on-Avon.*
335	1890. Nov.	Broughton, Thomas, 1, *Granville Road, Garston, Liverpool.*
391	1891. Apr.	‡Brown, George William, Serg.-Maj. R.E., 3, *Marle Hill Villas, Cheltenham.*
359	1891. Feb.	‡Brown, John, 8, *Paddock, Whitby.*

Reg. No. Date of Election.

579 1892. May. ‡Brown, Reginald, *Local Board Office, Ealing, W.*
591 1892. May. ‡Brown, Robert, Jun., 44, *St. Ann's Hill, Wandsworth, S.W.*
17 1888. Oct. ‡Brown, R. Railston, 1, *Blenheim Terrace, Bridlington Quay, Yorkshire.*
18 1888. Oct. ‡Brown, W. E., 19, *Havelock Road, Hastings.*
226 1890. Jan. ‡Bryan, George John, 4, *South Norwood Hill, S.E.*
486 1892. Jan. ‡Bryan, Joseph James, 27, *Oxford Street, Old Trafford, Manchester.*
415 1891. June. ‡Bubb, John Thomas, 1, *James's Parade, Bristol.*
19 1888. Oct. Buchan, W. Paton, *Fairyknowe, Cambuslang, Lanarkshire, N.B.*
20 1888. Oct. Buckeridge, Walter, *Ivy Grange, Sidlesham, near Chichester.*
681 1893. Jan. ‡Buckton, Walter, 27, *Ladbroke Square, W.*
21 1888. Oct. ‡Bugler, W. J., 6, *Burstock Road, Putney, S.W.*
104 1888. Dec. Burn, Robert G. N., 24, *Charing Cross, S.W.*
22 1888. Oct. Burroughs, S. M., *Snow Hill Buildings, E.C.*
521 1892. Feb. ‡Burslam, Randle, *Congleton, Cheshire.*
592 1892. May. ‡Butcher, Charles Ernest, 17, *Circus Road, St. John's Wood, N.W.*
178 1889. May. ‡Butland, R. J., *Town Hall, Lower Edmonton.*
688 1893. Feb. ‡Butler, Charles E., *Surveyor's Office, New Shoreham, Sussex.*
380 1891. Mar. ‡Butler, Walter, *Quay Street, Fareham, Hants.*
267 1890. Apr. ‡Butterworth, Arthur, *Board of Works, Maxey Road, Plumstead, S.E.*
142 1889. Feb. ‡Buxton, Anthony, *Carisbroke, Isle of Wight.*
654 1892. Oct. ‡Cannell, Charles Stephen, *Thorpe St. Andrew, Norwich.*
420 1891. June. ‡Carter, Alfred, 60, *Ashbrook Road, Upper Holloway, N.*
429 1891. July. ‡Cary, Aquilla S., 1, *Lily Villas, New Southgate.*
593 1892. May. ‡Cass, Robert William, 27, *Park Avenue, Church Lane, Pudsey.*
23 1888. Oct. ‡Catten, Joseph H., 32, *Exeter Street, Sloane Street, S.W.*
500 1892. Feb. ‡Cave, James, *Town Hall, Kensington, W.*
807 1893. Nov. ‡Cawsey, Thomas, 12, *Coedpenmaen Road, Pontypridd, Glamorganshire.*
664 1892. Dec. ‡Chalk, Joseph, *Waterworks Engineer's Office, Southampton.*
458 1891. Nov. Challoner, William, A.INST.E.E., *Blackpool, Lancaster.*
628 1892. Sept. ‡Chambers, Frederick, *Local Board Offices, Goole, Yorkshire.*
535 1892. Mar. ‡Chappell, William, 243, *Elgin Avenue, Maida Vale, W.*
710 1893. Feb. ‡Chesterfield, William James, 27, *Fernhurst Road, Fulham, S.W.*

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Reg. No. Date of Election.

809 1893. Nov. ‡Chouler, Ridgway Bentley, 1, *Calthorpe Street, Gray's Inn Road, W.C.*
720 1893. Apr. ‡Clark, John Edwin, 31, *Dalmore Road, West Dulwich, S.E.*
672 1893. Jan. ‡Clarke, Charles Henry, 2, *Rutland Terrace, High Road, Leyton.*
490 1892. Jan. ‡Clarke, Robert Edwyn, 5, *Gibson Square, Islington, N.*
25 1888. Oct. ‡Clarkson, Joseph, *Churchfield Terrace, Batley, Yorks.*
110 1889. Jan. ‡Clayton, Edward, *Sanitary Inspector, Mansfield, Notts.*
294 1890. June. ‡Clifton, Henry Chas., 50, *Porchester Road, Bayswater, W.*
26 1888. Oct. ‡Cobham, C., *The Shrubbery, Gravesend.*
27 1888. Oct. Cobham, G. R., 3, *Edwin Street, Gravesend.*
266 1890. Apr. ‡Cockburn, Henry Mace, *Town Hall, Spa Road, S.E.*
733 1893. May. ‡Codling, Henry, *West Boldon, Durham.*
346 1891. Jan. ‡Cole, A. C., 21, *West Street, Dorking.*
433 1891. July. ‡Collins, Henry Beale, M.O.H., *Glatton House, Kingston-on-Thames.*
483 1891. Dec. ‡Collyer, J., *Uttoxeter, Stafford.*
747 1893. May. ‡Conway, Isaac Henry Bugler, *Lillington, Sherborne, Dorset.*
556 1892. Apr. ‡Cook, Alfred, 35, *White Lion St., Norton Folgate, E.*
464 1891. Nov. ‡Cook, James, *Warton, Carnforth.*
339 1890. Dec. ‡Cook, William Gough, *Enmore, The Grove, Clapham Road, S.W.*
144 1889. Feb. ‡Cooper, William George, *Sanitary Inspector, Bournemouth.*
229 1890. Jan. ‡Copestick, George Christopher, 47, *Bateman Street, Derby.*
220 1890. Jan. ‡Corbett, Richard Lawrence, *Oakengates, Salop.*
135 1889. Jan. ‡Cordon, Robert Curtis, *Hillside Cottage, Duffield, Derby.*
411 1891. June. ‡Corp, James, 72, *St. George's Avenue, N.*
707 1893. Feb. ‡Corrigan, Joseph, 24, *Keble Street, Ince, Wigan, Lancashire.*
164 1889. Mar. ‡Cottle, Arthur Thomas, *Selly Oak, Birmingham.*
759 1893. June. ‡Cottrell, John, *Fallowfield, Manchester.*
443 1891. Oct. ‡Cowderoy, John Tatem, *Kidderminster, Worcester.*
810 1893. Nov. ‡Cowling, John Coombe, *Newton St. Cyres, Exeter.*
133 1889. Jan. ‡Cowper, Joseph, 181, *Brixton Road, S.W.*
345 1891. Jan. ‡Coxill, George E., *Vestry Hall, Cable Street, E.*
417 1891. June. ‡Crane, Joseph, 93, *Trafalgar Road, Gorleston, Great Yarmouth.*
656 1892. Nov. ‡Crane, Stephen, 8, *Dighton Road, Wandsworth, S.W.*
354 1891. Feb. ‡Crane, William Henry, 14, *Colonial Street, Hull.*
29 1888. Oct. ‡Croghan, Thomas Andrew, 37, *Devonshire Gardens, Buxton.*

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383 1891. Mar. ‡Cronk, Wm. Robert, *Cranford House, Cranford, Hounslow.*

247 1890. Feb. ‡Crosse, Hammond William, 1, *Deodor Road, Putney, S.W.*

248 1890. Feb. ‡Crossley, James, 1, *Maurice Street, Bolton Road, Pendleton.*

216 1890. Jan. ‡Crowther, William Christopher, 51, *Hind Street, Stockton-on-Tees.*

573 1892. May. ‡Cruden, John, *Inspector of Nuisances, Berwick-upon-Tweed.*

355 1891. Feb. ‡Culver, Thomas Henry, 99, *Cobden Road, South Norwood, S.E.*

601 1892. June. ‡Currie, Thomas, *Marshall Cottage, Hawkhill, Ayr.*

477 1891. Dec. Dalton, George, 3, *Ferns Avenue, Carrington, Nottingham.*

184 1889. June. ‡Daltry, John, 12, *King Street, Wellington, Salop.*

760 1893. June. ‡Dalrymple, Alexander, 17, *Wellington Street, Ayr, N.B.*

734 1893. May. Dance, Edwin Hubert, *Architect and Surveyor*, 10, *Quadrant Road, Thornton Heath, Surrey.*

612 1892. June. ‡Dane, Samuel, *Bird Nest Cottage, Primrose Lane, Glossop.*

30 1888. Oct. ‡Darley, George, 49, *St. Marks Street, Woodhouse, Leeds.*

561 1892. May. ‡David, Philip, 83, *Elm Street, Cardiff.*

543 1892. Oct. ‡Davies, Dan, *Ferndale, Rhondda Valley, Glamorgan.*

667 1893. Jan. ‡Davies, Edward Plummer, *Ty Eos-y-Coed, Llanover, Abergavenny.*

811 1893. Nov. ‡Davies, Miss Annie Mary, *The Gymnasium, Waterloo, Liverpool.*

715 1893. Apr. ‡Davies, Samuel, 6, *Edith Road, Anfield, Liverpool.*

812 1893. Nov. ‡Davies, Thomas, 79, *Walthall Street, Crewe, Cheshire.*

292 1890. May. ‡Davies, T. Lane, 1, *Albert Square, E.*

770 1893. June. ‡Davis, John Edward, 309, *King's Road, Chelsea, S.W.*

679 1893. Jan. ‡Dawes, Henry, 36, *Paignton Road, Stamford Hill, South Tottenham.*

562 1892. May. ‡Dawson, Edward Howard, 41, *Market Street, Lancaster.*

425 1891. June. ‡Dawson, John Marshall, 93, *Malpas Road, Brockley.*

300 1890. June. ‡Dawson, William, 6, *Brooklands Road, Birkenhead.*

254 1890. Mar. ‡Dean, Samuel Saunders, *Hugglescote, Ashby-de-la-Zouch.*

312 1890. June. ‡Dee, Thomas George, 17, *Grosvenor Road, S.W.*

647 1892. Oct. ‡Denham, Hodgson, *Sanitary Inspector & Surveyor, Aberford, near Leeds.*

100 1888. Dec. Densham, Charles A., 42, *Wellington Road, St. John's Wood, N.W.*

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621 1892. July. ‡Dewhirst, James, *Woodbine Cottage, Merrow, Guildford, Surrey.*

782 1893. July. ‡Dilke, Francis Henry, 24, *City Road, Bristol.*

482 1891. Dec. ‡Docking, Frederick Reynolds, 56, *George Street, Croydon, S.W.*

655 1892. Oct. ‡Dodgson, William, *Cononley, York.*

234 1890. Jan. Dover, John Henry, 13, *King Street, Kensington Square, W.*

454 1891. Nov. ‡Dowsing, Alfred, 2, *Mawney's Villas, Romford.*

111 1889. Jan. ‡Drake, W. Medley, *Fisher Street, Spring Dale, Huddersfield.*

241 1890. Feb. ‡Dunbar, David, 24, *George Square, Glasgow, N.B.*

813 1893. Nov. ‡Dunn, James Stephen, *The Poplar Board of Works, London, E.*

450 1891. Nov. ‡Duthie, Alexander, *Kirkcaldy District Committee, Markinch, Fife, N.B.*

145 1889. Feb. ‡Dyer, Samuel, 3, *Wellington Road, Bridlington Quay.*

408 1891. June. ‡Dyke, Alfred William, *St. John's Wharf, Wandsworth Bridge, Fulham, S.W.*

112 1889. Jan. ‡Dyson, John Henry, *St. George's Terrace, Thornhill, near Dewsbury.*

113 1889. Jan. ‡Edmonds, William H., *Vestry Hall, Hampstead, N.W.*

333 1890. Nov. Edwards, John, 16, *Gladstone Street, St. George's Rd., S.E.*

596 1892. June. ‡Ellis, Stanley, 28, *Chertsey Street, Guildford.*

736 1893. May. ‡Elms, Thomas Hood, 43, *Mall Road, Hammersmith, W.*

31 1888. Oct. ‡Emptage, Daniel, *Dane Hill Sanitary Works, Margate.*

32 1888. Oct. ‡Evans, John Evan, 99, *Prince of Wales Road, N.W.*

563 1892. May. ‡Evans, John Isaac, *Surveyor's Office*, 2, *Talbot Street, Aberavon, Port Talbot.*

771 1893. June. ‡Evans, Percival Baker, 16, *Irene Road, Poole Park, Fulham, S.W.*

290 1890. May. ‡Evington, Charles William, 12, *Bridlington Street, Hull.*

33 1888. Oct. ‡Fairchild, Samuel C. G., 569, *Wandsworth Road, Clapham, S.W.*

353 1891. Feb. ‡Fairey, Alfred Isaac, 5, *Tavistock Street, Covent Garden, W.C.*

772 1893. June. ‡Few, Herbert Arthur, 19, *Highbury Park, N.*

252 1890. Mar. Finch, William, 172, *Beverley Road, Hull.*

114 1889. Jan. ‡Fincher, John Gazeley, 30, *Edward St., Aldershot.*

572 1892. May. ‡Fisher, Robert, 9, *King William Street, Greenwich, S.E.*

476 1891. Nov. ‡Foad, Cephas, *Board of Works*, 117, *High Street, Poplar, E.*

297 1890. June. ‡Folland, John Percy, 22, *Liverpool Street, King's Cross, N.W.*

35 1888. Oct. ‡Fordham, Wm. Francis, *Hampton House, High Road, Kilburn, N.W.*

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281 1890. May. ‡Forrester, William, *Staplehurst, Kent.*

36 1888. Oct. France, T. W. Chapman, 36, *Bristol Road, Edgbaston.*

722 1893. Apr. ‡French, Harry Cramphorn, 13, *Lanhill Road, Paddington, W.*

94 1888. Oct. Gairdner, Prof. W. T., M.D., LL.D., F.R.S., *The University, Glasgow.*

96 1888. Nov. ‡Gardner, C. T., *Town Hall, Worthing.*

37 1888. Oct. ‡Garland, Wm., 12, *Higher Maudlin Street, Barnstaple.*

613 1892. June. ‡Garnham, Albert Edward, *Beulah Hill, Norwood, S.E.*

38 1888. Oct. Gass, John Bradshaw, F.R.I.B.A., 19, *Silverwell Street, Bolton.*

186 1889. June. ‡Gathercole, William Henry Joseph, *Sanitary Inspector, Guildhall, E.C.*

725 1893. Apr. ‡Geary, Reginald, 4, *Hampstead Square, Hampstead, N.W.*

761 1893. June. ‡Gentry, Herbert John, 63, *Loftus Road, Shepherd's Bush, W.*

787 1893. July. ‡Gibbard, John Richard, 5, *Old Tiverton Road, Exeter.*

260 1890. Mar. ‡Gibson, John, *Health Offices, North Church Street, Sheffield.*

158 1889. Mar. ‡Gilbeart, John Joseph, 11 & 12, *Little Chester Street, Belgrave Square, W.*

418 1891. June. ‡Gillespie, Rev. Charles George Knox, 2, *Darwin Terrace, Derby.*

394 1891. April. ‡Godsall, Henry John, *Park Road, Saltley, Birmingham.*

604 1892. June. ‡Golder, Thomas Collings, 5, *Connaught Road, Folkestone.*

797 1893. Oct. ‡Golds, Thomas William, 13, *Crompton Street, Paddington, W.*

738 1893. May. ‡Goodall, Norman, *Russell Street, Batley, Yorkshire.*

503 1892. Feb. ‡Goodman, Herbert, 4, *Clapton Common, N.E.*

39 1888. Oct. ‡Goodwyn, Arthur Ayde, 34, *Church Road, Richmond, Surrey.*

519 1892. Feb. ‡Gorniot, Thomas Arthur, 59, *Great James Street, Lisson Grove, N.W.*

360 1891. Feb. ‡Gough, Joseph, 7, *Malvern Terrace, St. Paul's Road, Tottenham.*

474 1891. Nov. ‡Grant, Alexander, *Town Hall, Chelsea, S.W.*

814 1893. Nov. ‡Grant, Ernest Henry, *Town Hall, Worthing, Sussex.*

115 1889. Jan. ‡Grant, Walter, 18, *Gildredge Road, Eastbourne.*

438 1891. July. ‡Green, Edward Albert, 16, *Rock Street, Bridgehouses, Sheffield.*

361 1891. Feb. ‡Green, William, 6, *Meredith St., Clerkenwell, E.C.*

187 1889. June. ‡Greenwell, Allan, *Surveyor's Office, Frome.*

40 1888. Oct. Gribble, Miss Sarah C.

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739 1893. May. ‡Griffin, Thomas Gulliver, *Laurel Cottage, Thanet Street, Clay Cross, Derby.*

362 1891. Feb. ‡Grigg, William Henry, 2, *Acford Road, South Fulham, S.W.*

302 1890. June. Grinham, Philip Boys, *Tichborne Down, Alresford.*

419 1891. June. ‡Grivell, Elias James, *Storrington, Sussex.*

41 1888. Oct. ‡Gunn, Alexander, 118, *King Street, Aberdeen.*

799 1893. Oct. Hale, Alexander, *Chief Sanitary Inspector of the Municipality of Simla, in the Punjab Province of British India, Myrtle Villa, Simla, Punjab, British India.*

230 1890. Jan. ‡Hall, George Berringer, F.G.S., 10, *Waldemar Avenue, Fulham Road, S.W.*

653 1892. Oct. ‡Hall, John, *Poundfield, Stonehouse, Gloucester.*

629 1892. Sept. ‡Hall, Thomas John, 17, *Regent Street, Barnsley, Yorkshire.*

740 1893. May. Halligan, William, *Sanitary Engineer, Trevellyan Street, Elsternwick, near Melbourne, Victoria, Australia.*

624 1892. Sept. ‡Hammond, William Henry, *South Parade, Horbury, Wakefield, Yorkshire.*

789 1893. July. ‡Hannant, William B., 34, *Blenheim Terrace, St. John's Wood, N.W.*

726 1893. Apr. ‡Hanson, J. H., 6, *Trinity Terrace, Camp Hill, Birmingham.*

704 1893. Feb. ‡Hargreaves, James Wm., 296, *New Church Road, Stacksteads, Lancashire.*

815 1893. Nov. ‡Harrison, Edward Stanhope, *The Guildhall, Swansea, Glamorganshire.*

197 1889. June. ‡Harrison, George, *Thurnby, Leicester.*

376 1891. Mar. ‡Harrison, William Henry, *Health Offices*, 6, *North Church Street, Sheffield.*

42 1888. Oct. ‡Harrison, Wm. L., 7, *Dock Street, Hull.*

686 1893. Feb. ‡Hart, John William, 12, *Andalus Road, Stockwell, S.W.*

43 1888. Oct. ‡Hart, W. S., 29, *Coley Hill, Reading.*

377 1891. Mar. ‡Hartnoll, Francis, 49, *St. Paul's Road, Burdett Road, E.*

800 1893. Oct. ‡Harvey, William, 117, *Dunlace Rd., Lower Clapton, N.E.*

448 1891. Oct. ‡Hatton, Charles, *Claremont, Mexfield Road, Putney, S.W.*

219 1890. Jan. ‡Hay, Alexander, 56, *George Square, Glasgow.*

773 1893. June ‡Head, Arthur Parr, 39, *Barnsdale Road, Paddington, W.*

44 1888. Oct. ‡Head, Robert H., 7, *Upper Baker Street, N.W.*

465 1891. Nov. ‡Heaps, William, Junr., 28, *Parker Street, Chorley, Lancashire.*

45 1888. Oct. Hearn, Walter, 62, *Grove Park Terrace, Grove Park, Chiswick, W.*, (27, *Mecklenburgh Sq., W.C.*).

Reg. No. Date of Election.

46 1888. Oct. ‡Hearne, William, *Buenos Ayres.*

534 1892. Mar. ‡Hebden, Joseph Henry, 6, *Marlborough Terrace, South Boulevard, Hull.*

192 1889. June. ‡Helsdon, Horace, 14, *St. Edmunds Terrace, Primrose Hill, N.W.*

577 1892. May. ‡Henley, Amos S., 57, *Lessada Street, Roman Road, Victoria Park, E.*

467 1891. Nov. ‡Herbert, Harry, 30, *Westbourne Road, Sunderland.*

727 1893. Apr. ‡Hill, Samuel Gostage, 14, *Aigburth Road, Grassendale, Liverpool.*

259 1890. Mar. ‡Hills, Arthur Reginald, 24, *Harley Street, Bow, E.*

668 1893. Jan. ‡Hillyard, Henry, 74, *Duncombe Road, Hornsey Rise, N.*

101 1888. Dec. ‡Hobbs, W. F., 36, *Melbourne Street, Stalybridge.*

255 1890. Mar. ‡Hodges, Albert, 57, *Hall Street, Blakenhall, Wolverhampton.*

741 1893. May. ‡Holden, Timothy, 272, *City Road, Manchester.*

282 1890. May. ‡Holland, Percy, *Fairstead Cottage, Newmarket.*

638 1892. Sept. ‡Holmes, John Edward, *North Collingham, Newark.*

790 1893. July. ‡Hooper, Thomas Henry, 84, *Bond Street, Vauxhall, S.W.*

194 1889. June. ‡Hooper, Thomas Rowland, *Redhill, Surrey.*

222 1890. Jan. ‡Hooper, William, 8, *Lucas Road, Penge, S.E.*

510 1892. Feb. ‡Horlock, Charles William, *Little Horsted, Uckfield.*

47 1888. Oct. Horncastle, Henry, *Lindisaye, Palmerston Road, Woking.*

462 1891. Nov. ‡Horner, Benjamin Roper, *Sanitary Inspector, Town Hall, West Bromwich.*

49 1888. Oct. ‡Horrocks, Joseph, 10, *Union Street, Southport.*

494 1892. Feb. ‡Horton, Richard, 8, *Orford Street, Chelsea, S.W.*

536 1892. May. ‡Horton, William, 22, *Halsey Street, Chelsea, S.W.*

690 1893. Feb. ‡Hoskins, Nandy William, 7, *Boundary Road, Chatham.*

116 1889. Jan. ‡Houghton, Robert Alfred, 5, *Merton Hall Road, Wimbledon, S.W.*

331 1890. Nov. ‡Hughes, Edward J., 102, *Camden Street, Birkenhead.*

475 1891. Nov. ‡Hughes, Walter, *Thompson Street, Bilston.*

661 1892. Nov. ‡Hunt, William Edward, 1, *Ashmead Road, St. John's, S.E.*

675 1893. Jan. ‡Hunter, John, *New Windsor.*

239 1890. Feb. ‡Ingram, William Jones, *Goldsworth Road, Woking.*

484 1891. Dec. ‡Inskip, Frederick Thomas, *Dilhorne, Stoke-on-Trent.*

546 1892. Mar. ‡Irving, William, *Town Hall, Shrewsbury.*

611 1892. June. ‡Jackling, William, *Inspector's Office, Fair Meadow, Maidstone.*

317 1891. Feb. ‡Jackson, Henry James, *Rye Road, Hoddesdon, Herts.*

742 1893. May. ‡Jackson, Thomas, 288, *New Hall Lane, Preston, Lancashire.*

415 1891. Oct. ‡Jackson, William, *Health Office, North Church St., Sheffield,* (181, *Clough Road, Sheffield.*)

Reg. No. Date of Election.

251 1890. Feb. Jacob, Oswald, *Sanitary Inspector, Feltham, Middlesex.*

728 1893. Apr. ‡Jarratt, Edward John, *Morden Lodge, Albion Hill, Lewisham Road, S.E.*

444 1891. Oct. ‡Jarvey, George, *Town Hall, Salford.*

235 1890. Jan. ‡Jellis, John, 11, *Arodene Road, Brixton, S.W.*

816 1893. Nov. ‡Jenkins, David, *Port Sanitary Offices, Docks, Cardiff, Glamorganshire.*

207 1889. July. ‡Jenner, Richard Messenger, *Parade Road, Sandgate.*

674 1893. Jan. ‡Jevons, John H., *Braintree, Essex.*

774 1893. June. ‡Johns, David James, 28, *Gelli Road, Ton Pentre, Rhondda Valley, Glamorganshire.*

374 1891. Feb. ‡Johnson, H. Watts, *Manor House, Little Berkhampstead, Herts.*

286 1890. May. ‡Johnson, John William, 43, *Bromley Street, Commercial Road, E.*

330 1890. Nov. ‡Johnson, Joseph Edward, *Medical Officer of Health's Department, Town Hall, Hull.*

455 1891. Nov. ‡Johnson, Matthew, 31, *Palmer Street, Jarrow.*

299 1890. June. Jones, John, 40, *Sydney Street, Chelsea, S.W.*

329 1890. Nov. ‡Jones, Julius Morris Wilson, 24, *St. Agnes Place, Kennington Park, S.E.*

189 1889. June. ‡Jones, William, *Cemlyn, Dolgelly, Merioneth.*

258 1890. Mar. ‡Jours, William, *Town Hall, Gateshead-on-Tyne.*

342 1890. Dec. ‡Jury, H. A., *North-East Lodge, Chelsea Bridge, Grosvenor Road, Pimlico, S.W.*

50 1888. Oct. ‡Keal, J., *Southview Hill Road, Sutton, Surrey.*

581 1892. May. ‡Kelf, Charles Harvey, 13, *Victoria Avenue, Upton Park, Essex.*

51 1888. Oct. ‡Kemsley, Jesse, 76, *Queen's Road, Bayswater, W.*

529 1892. Mar. ‡Kennedy, Daniel, 19, *Tremlett Grove, Junction Road, N.*

407 1891. June. ‡Kershaw, Edward Baxter, *Hinton*, 64, *Theale Road, Streatham, S.W.*

52 1888. Oct. ‡Kiell, John, 103, *High Street, Barnstaple.*

582 1892. May. ‡Kilgallin, Charles J., 55, *Marylebone Road, W.*

439 1891. July. ‡King, Albert S. W., 31, *Mervan Road, Brixton, S.W.*

762 1893. June. ‡King, Claude, 24, *Prince of Wales Road, Norwich, Norfolk.*

149 1889. Feb. ‡King, Frederick William, *Heybridge, Maldon, Essex.*

570 1892. May. ‡Kirk, William Hugh, *Town Hall, Newcastle-upon-Tyne.*

817 1893. Nov. ‡Kirk, William Willey, 17, *Waterway Street West, Nottingham.*

53 1888. Oct. Kite, Charles, 31, *Barronsmere Road, East Finchley.*

274 1890. May. ‡Knight, Robert, Junr., *Abbot House, Dunfermline, Fife.*

150 1889. Feb. ‡Knight, William Henry, *Dulce Domun, Gisburn Road, Hornsey, N.*

568 1892. May. Knowles, James Edward, 9, *System Street, Cardiff.*

Reg. No. Date of Election.

775 1893. June. ‡Ladd, H. F. B., 5, *Crompton Terrace, Walmer, Kent.*
763 1893. June. ‡Lamble, Phillip T., 14, *Chichester Street, W.*
603 1892. June. ‡Lamport, Miss Ethel Frances, 55, *Burton Crescent, W.C.*
190 1889. June. ‡Lander, James, 19, *Millbank Street, Westminster.*
55 1888. Oct. ‡Lapworth, J., *Vestry Hall, Bethnal Green, E.*
214 1889. Nov. ‡Laurie, John, *The Lawn, Iffley, Oxon.*
729 1893. Apr. ‡Lawrence, James, 12, *Bridge Road West, Old Battersea, S.W.*
743 1893. May. ‡Lawson, Archibald, 103, *Leinster Road, Rathmines, Dublin.*
717 1893. Apr. ‡Leach, Robert, 6, *Barton Street, Westminster, S.W.*
459 1891. Nov. ‡Lear, Charles F. E., *Alverstoke, Hampshire.*
131 1889. Jan. ‡Lear, James Walter, 122, *Southgate Road, N.*
159 1889. Mar. ‡Lee, James, 28, *Franchise Street, Rochdale.*
56 1888. Oct. ‡Legg, S. C., 117, *Powerscroft Road, Lower Clapton, N.E.*
516 1892. Feb. ‡Leigh, Frederick George, *Cottage Hospital, Dover, Kent.*
102 1888. Dec. ‡Lennox-Clarke, A.
683 1893. Feb. ‡Leverton, John Henry, *Sanitary Inspector, St. John's, Hampstead, Vestry Hall, Haverstock Hill, and* 45, *Lisburne Road, Hampstead, N.W.*
117 1889. Jan. ‡Lewis, Arthur, *Isham, Wellingborough.*
364 1891. Feb. ‡Lewis, Charles, *Newland Street, Witham, Essex.*
783 1893. July. ‡Lewis, James, 17, *Heyford Avenue, South Lambeth Road, S.W.*
57 1888. Oct. ‡Lightfoot, Thos., 1, *Langsyne Villas, Forest Road, Kew.*
291 1890. May. ‡Lightfoot, William Charles, 37, *Fernshaw Road, King's Road, Chelsea, S.W.*
236 1890. Jan. ‡Lilly, William Gent, 5, *Whitcomb Street, W.C.*
549 1892. Mar. ‡Lindley, Joseph, *Cliffe Villa, Stanicliffe, Dewsbury.*
744 1893. May. ‡Lintott, John, 80, *London Road, Brighton, Sussex.*
328 1890. Nov. ‡Little, William, *Health Office, North Church Street, Sheffield.*
437 1891. July. ‡Locke, Walter Richard, *Bedford House, Aylesbury.*
768 1893. June. ‡Lockwood, Arthur Charles, 49, *Queen's Road, Crown Hill, Norwood, S.E.*
344 1891. Jan. Longsdon, Ernest M., *Surveyor, Town Hall, Bakewell.*
818 1893. Nov. Loudon, John Baird, *Rosslyn Villa, Warwick Road, Coventry.*
468 1891. Nov. ‡Lowry, John, *Grove Villa, Bradmore, Wolverhampton.*
118 1889. Jan. ‡Lukes, Arthur Henry, *Town Hall, Gravesend.*
327 1890. Nov. ‡Lund, Clifton, 9, *Bridge Street, Southport.*
58 1888. Oct. ‡Lund, Jeremiah, *St. James's Vestry, Piccadilly, W.*
623 1892. July. ‡Lyon, James Joseph, 6, *Rice Lane, Walton-on-the-Hill, Liverpool.*
61 1888. Oct. MacIntosh, James, 38, *Langham Street, W.*

Reg. No.	Date of Election.	
171	1889. Apr.	Mackay, James John, 186, *Kensal Road, W.*
237	1890. Feb.	‡Maclennan, John, *Carnock House, Carnock, Dunfermline.*
680	1893. Jan.	‡Madge, Frank William, 46, *London Road, Forest Hill, S.E.*
471	1891. Nov.	‡Madin, William B., *Town Hall, Leek.*
421	1891. June.	‡Mager, Frederick Walter, *Rural Sanitary Authority, Durngate Street, Dorchester.*
272	1890. May.	‡Malcolm, Alfred, *Clayton, Manchester.*
496	1892. Feb.	‡Malvern, Thomas, *Winchcombe Street, Cheltenham.*
692	1893. Feb.	‡Marrable, Horace, 130, *Latchmere Road, Clapham Junction, S.W.*
518	1892. Feb.	‡Martin, Robert, 17, *Wawne Street, Spring Bank, Hull.*
442	1891. Oct.	‡Martin, William, Junr., *Glenburn, Carluke, N.B.*
398	1891. Apr.	‡Mason, Frederick William, 22, *Main Avenue, Bush Hill Park, Enfield.*
261	1890. Apr.	Mason, Jonathan, 1, *Grove Terrace, Grove Road, Leytonstone.*
59	1888. Oct.	‡Mathias, H. D., 140, *Smithdown Road, Liverpool.*
509	1892. Feb.	‡Matthews, Frederick, *Kedleston, Derby.*
715	1893. May.	‡Matthews, Henry, *Grimley, Worcester.*
373	1891. Feb.	‡Matthews, William, *Kedleston, Derby.*
523	1892. Feb.	‡Maxwell, William Henry, *Local Board, Town Hall, Leyton, E.*
386	1891. Mar.	‡Mayne John William, *Sanitary Inspector, Wimbledon, S.W.*
151	1889. Feb.	‡May, William H., *Inspector's Office, Guildhall, E.C.*
60	1888. Oct.	‡McDonald, A. L., 37, *George Street, Gipsy Hill, S.E.*
625	1892. Sept.	‡Meadows, John W., 52, *Camden Street, North Shields, Northumberland.*
644	1892. Oct.	‡Meazey, Thomas, 1, *Stanwell Road, Penarth.*
103	1888. Dec.	Merrill, John, *Albany Road, Sheffield.*
138	1889. Jan.	‡Millard, William David, *Roslin, Ellington Road, Ramsgate.*
594	1892. June.	‡Miller, Frederick William, 137, *Salcott Road, Clapham Common, S.W.*
499	1892. Feb.	‡Mills, Joshua George, *North Road, West Kirby, Cheshire.*
432	1891. July.	‡Milner, Walter, 40, *Sackville Street, W.*
315	1890. Oct.	‡Milner, William, 116, *Park Road, Chorley.*
62	1888. Oct.	‡Minty, Samuel, *The Triangle, Bournemouth.*
381	1891. Mar.	‡Misselbrook, G. T., 2, *Percy Road, Fawcett Road, Southsea.*
640	1892. Sept.	Mitchell, Charles Frederick, 55, *Queen's Crescent, Haverstock Hill, N.W., and The Polytechnic, Regent's Street, W.*
249	1890. Feb.	Mitchell, Edward, 25, *St. Saviour's Road, Croydon, S.W.*

Reg. No.	Date of Election.	
308	1890. June.	‡Moody, Henry Fred, 37, *Hare Street, Great Grimsby.*
700	1893. Feb.	‡Mooney, Patrick, 353, *Chester Road, Manchester.*
801	1893. Oct.	‡Morgan, William, 11, *Bute Crescent, Pontyclun, Glamorganshire.*
619	1892. July.	‡Morrison, John William, *Town Hall, Salford, Lancaster.*
402	1891. Apr.	‡Mosley, Abraham, *Goodyear Chambers, Abingdon Square, Northampton.*
480	1891. Dec.	‡Moss, Samuel, *Williamson Street, Tunstall.*
495	1892. Feb.	‡Munro, Andrew John, *Fairlight, Birkbeck Road, Enfield.*
566	1892. May.	Nayler, Edward, 140, *Lake Road, Landport, Portsmouth.*
201	1889. July.	‡Nettleton, Charles William, 16, *Winchester Terrace, Westminster, S.W.*
585	1892. May.	‡Newnham, Frank George, 14, *South Norwood Hill, S.E.*
575	1892. May.	Newson, George John, 25, *Gertrude Street, West Brompton, S.W.*
384	1891. Mar.	‡Nicholas, David, 256, *Essex Road, Canonbury, N.*
497	1892. Feb.	‡Norman, Ernest William, 4, *Dawes Road, Forest Gate, E.*
105	1888. Dec.	Norris, Joseph, *Sunningdale, Ascot, Surrey.*
257	1890. Mar.	‡Norrish, John Thomas, 9, *Cuthbert Road, Brighton.*
713	1893. Feb.	‡Norton, Elizabeth Jane, *Maida Vale Mansions, W.*
285	1890. May.	‡Nurcombe, Benjamin, 1, *Jasmine Terrace, Wurtemberg Street, Clapham, S.W.*
295	1890. June.	‡Nutley, Charles Vernon, 11, *Dalling Road, Hammersmith, W.*
317	1890. Oct.	‡Oliver, G., 14, *St. John's Road, Waterloo, Liverpool.*
160	1889. Mar.	‡Ollett, John Henry, *Sanitary Inspector, Eastbourne.*
764	1893. June.	‡Ollis, John James, *Hill Farm, Saltford, Bristol.*
649	1892. Oct.	‡Orchardson, Robert, 88, *North Road, St. Helens, Lancashire.*
213	1889. Nov.	Ord, James, 11, *Portman Street, W.*, (41, *Upper George Street, W.*).
522	1892. Feb.	‡Orrell, Thomas, 44, *Vernon Street, Darwen.*
639	1892. Sept.	‡Osborne, Walter, 13, *Third Street, Bensham, Gateshead.*
466	1891. Nov.	‡Outram, Mason, 35, *Stafford Street, Derby.*
776	1893. June.	‡Owen, William, *Glyn Garth Post Office, Anglesea.*
748	1893. May.	‡Pacy, William, *Verona Villas, Arboretum Road, Worcester.*
64	1888. Oct.	Palliser, Christopher, *Northallerton.*
709	1893. Feb.	‡Palmer, Herbert Albert, 70, *Leander Road, Josephine Avenue, Brixton Hill, S.W.*
791	1893. July.	‡Palmer, Isaac Fairley, *Ewell Road, Surbiton Hill, S.W.*

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622 1892. July. ‡Palmer, James, 1, *Tanner's Hill, Broadway, Deptford, S.E.*

650 1892. Oct. ‡Pank, Richard Arnold, *St. Andrew's, Norwich.*

409 1891. June. ‡Paramor, Robert Walter, 16, *Randolph Gardens, Dover.*

277 1890. May. ‡Parham, John, Junr., 5, *Edison Road, Crouch End, N.*

666 1893. Jan. ‡Parkinson, Arthur Charles, 27, *Southampton Row, W.C.*

478 1891. Dec. Parkinson, Herbert William, 11, *Gloucester Road, South Kensington, S.W.*

705 1893. Feb. ‡Parsley, Frederick Wm., 3, *Upper Montagu Street, Montagu Square, W.*

670 1893. Jan. ‡Patching, Walter C., 9, *Chapel Road, Worthing.*

671 1893. Jan. ‡Patching, William George, *Belfort, Worthing.*

765 1893. June. ‡Paterson, Arthur William, *Station Road, New Barnet, Herts.*

288 1890. May. ‡Pattison, William Phillip, *White House, Benwell, Newcastle-on-Tyne.*

414 1891. June. ‡Peake, Thomas Jones, 61, *Wybunbury Road, Willaston, Nantwich.*

427 1891. June. Pearce, Frederick James, *Borough Surveyor's Office, Kingston-on-Thames.*

66 1888. Oct. ‡Pearson, John, *Sanitary Inspector, Grace Hill, Folkestone.*

788 1893. July. ‡Pengelly, John Isaac, 15, *St. James's Road, Exeter.*

97 1888. Nov. ‡Perry, Arthur, 45, *Townshend Road, St. John's Wood, N.W.*

153 1889. Feb. ‡Pettit, George Mackness, 22, *Chesterton Road, North Kensington, W.*

684 1893. Feb. ‡Phillips, Charles, 68, *Swinton Street, Gray's Inn Road, W.C.*

289 1890. May. ‡Phillips, Henry, 66, *Park Lane, Earlham Road, Norwich.*

627 1892. Sept. ‡Pidwell, Engall Thomas, 12, *Peak Hill Avenue, Sydenham, S.E.*

819 1893. Nov. ‡Piercy, Edmund Ernest, 20, *Fentiman Road, Clapham, S.W.*

430 1891. July. ‡Pilbeam, Francis Newcastle, 72, *Davenport Road, Shepherd's Bush, W.*

367 1891. Feb. ‡Pillow, Mrs. Margaret Eleanor, 2, *Carlton Terrace, Mill Hill Road, Norwich.*

730 1893. Apr. ‡Pitchforth, Samuel A., 3, *Chestnut Villas, Foleshill, Warwick.*

233 1890. Jan. Poole, James, 2, *Trafalgar Place, Kensington, W.*

702 1893. Feb. ‡Porter, John James, *Halse Road, Brackley, Northampton.*

67 1888. Oct. ‡Potter, Ben, 17, *Ranelagh Road, Ealing, W.*

Reg. No.	Date of Election.	
798	1893. Oct.	‡Potter, Edwin James, *Honiton House, Saltram Crescent, W.*
121	1889. Jan.	‡Potter, Thomas Wickford, *Estate Works, Thoresby Park, Ollerton, Notts.*
123	1889. Jan.	‡Pratt, Joseph, 12, *Kirkdale, Sydenham, S.E.*
161	1889. Mar.	‡Press, William James, *Rose Villa, Abingdon Street, Burnham, Somerset.*
820	1893. Nov.	‡Preston, Alfred Pearce, 42, *Arran Street, Cardiff, Glamorganshire.*
645	1892. Oct.	Pringle, Andrew, *Cromwell House, Bexley Heath, Kent.*
68	1888. Oct.	Proger, John L., 11, *Cwrtiy-vie Road, Penarth, Cardiff.*
703	1893. Feb.	‡Puddle, Walter Louis, 17, *Somerville Terrace, Sheffield, Yorkshire.*
750	1893. May.	‡Purnell, Arthur Edward, 123, *Harbut Road, New Wandsworth, S.W.*
802	1893. Oct.	‡Quick, Edward Hare, *Sanitary Inspector, Lympstone, Devon.*
69	1888. Oct.	‡Rains, Joseph, *Kettering.*
694	1893. Feb.	‡Rance, John Walter, 111, *Page Street, Westminster, S.W.*
784	1893. July.	‡Rayner, George, *The Green, Downham Market, Norfolk.*
701	1893. Feb.	‡Read, Walter Herbert, 1, *Cornwall Terrace, N.W.*
517	1892. Feb.	‡Reavell, Frank Noble, 97, *Benthall Road, Stoke Newington, N.*
70	1888. Oct.	‡Reavell, George, Jun., *Alnwick, Northumberland.*
731	1893. Apr.	‡Reid, Thomas Alexander, *Care of D. Reid, Ley of Hallyburton, Coupar-Angus.*
71	1888. Oct.	‡Richards, Daniel, *Elwyn Villa, South Molton.*
606	1892. June.	‡Richards, William, 18, *Nunhead Grove, Peckham Rye, S.E.*
803	1893. Oct.	‡Richardson, Frederick, *High Street, Brasted, Sevenoaks, Kent.*
723	1893. Apr.	‡Ritchie, Peter, 23, *Georgiana Street, Camden Town, N.W.*
751	1893. May.	‡Roberts, Peter James, 141, *Union Street, Ashton-under-Lyne, Lancashire.*
263	1890. Apr.	‡Robertson, John Shirras, *Princes Street, Thurso.*
618	1892. July.	‡Robins, H. G., 29, *West End Lane, N.W.*
228	1890. Jan.	‡Robinson, John, 79, *Lavender Road, Clapham Junction, S.W.*
507	1892. Feb.	‡Robson, Lancelot, 12, *Stockton Street, West Hartlepool.*
633	1892. Sept.	‡Rodwell, Ascough, *Union Offices, Skipton, Yorkshire.*
440	1891. July.	‡Roe, Edward Charles, Junr., 23, *Oxberry Avenue, Fulham, S.W.*
72	1888. Oct.	‡Rogers, Richard, *Maes Helew, Carnarvon.*

Reg. No. Date of Election.

589 1892. May. ‡Roper, Joseph Stanley, *Surveyor and Inspector to Rural Sanitary Authority, Greenway Court, Hollingbourne, Maidstone.*

706 1893. Feb. ‡Roshier, Edward, 31, *York Street, Unthanks Road, Norwich.*

422 1891. June. ‡Rossiter, Robert Herbert, 15, *Sloane Terrace, Sloane Street, Chelsea, S.W.*

648 1892. Oct. ‡Rothera, Frederick, 13, *South View, Sowerby Bridge, Yorkshire.*

620 1892. July. ‡Row, Edmund, 154, *Barking Road, Canning Town, Essex.*

449 1891. Nov. Rowe, William Thomas Ferdinand, 41, *Old Town Street, Plymouth.*

463 1891. Nov. ‡Rowland, Arthur, 5, *Cambridge Street, Hull.*

605 1892. June. ‡Rowland, Samuel, *Local Board Offices, Pontypridd.*

565 1892. May. ‡Royle, Charles, 51, *Wormgate, Boston, Lincoln.*

766 1893. June. ‡Rugg, John Edward, *The Vestry of St. Luke's, City Road, E.C.*

792 1893. July. ‡Rugg, Samuel Horace, 165, *Earls Court Road, Kensington, W.*

283 1890. May. ‡Ruscoe, Ernest Henry, 6, *Great Castle Street, Regent Street, W.*

691 1893. Feb. ‡Ruscoe, Frank Harvey, 6, *Great Castle Street, Regent Street, W.*

724 1893. Apr. ‡Rushton, Egbert, 9, *Kendal Street, Blackburn.*

205 1889. July. ‡Ryder, Albert Thomas, 2, *Cavendish Street, Bedford.*

125 1889. Jan. ‡Sadleir, Richd. J., *Woodcote, Ormeley Road, Balham, S.W.*

73 1888. Oct. ‡Salter, Thomas, 2, *King's Road, St. Leonards-on-Sea.*

719 1893. May. ‡Sanderson, Isaac, *Sunnybrow, Willington, Durham.*

580 1892. May. ‡Sandon, Edward H., 327, *Harrow Road, W.*

293 1890. May. ‡Saunders, Percy, 46, *Jarvis Road, South Croydon, S.W.*

785 1893. July. ‡Schlund, William Theodore, 46, *Kemp Street, Brighton.*

689 1893. Feb. ‡Scott, Sarah, 130, *Strand Road, Bootle, Liverpool, Lancashire.*

74 1888. Oct. Sedgwick, Sydney, *Sidmouth Villa*, 195, *Tulse Hill, S.W.*

793 1893. July. ‡Sharman, Edward Mansfield, 104, *Acomb Street, Greenheys, Manchester.*

660 1892. Nov. Sharpe, William Charles, *Morecambe Villa, Great Grimsby, Lincoln.*

240 1890. Feb. ‡Shaw, Peter, 98, *Church Street, Fulham Road, S.W.*

676 1893. Jan. Shearing, Arthur George, 308, *Kentish Town Road, N.W.*

Reg. No. Date of Election.

126 1889. Jan. ‡Sheldon, W. E., *c/o R. J. Sheldon, Esq., Thanet Villa, Buckhurst Hill.*

513 1892. Feb. ‡Shill, Albert Edmund, 108, *College Place, N.W.*

77 1888. Oct. ‡Shore, Ambrose J., 68, *Adys Road, East Dulwich, S.W.*

172 1889. Apr. ‡Short, James Allen, *Sanitary Department, Wigan.*

551 1892. Apr. ‡Shuttleworth, William, *Town Hall, Salford, Lancashire.*

173 1889. Apr. ‡Sidwell, Henry Thomas, *Blean District Surveyor's Office, near Railway Station, Herne Bay, Kent.*

428 1891. July. ‡Simmons, Edward John, 80, *Paulet Road, Camberwell, S.E.*

78 1888. Oct. ‡Simmons, Nimrod, *Glendale, Clifton, Bristol.*

821 1893 Nov. ‡Simms, Frederick, 29, *Adelaide Street, St. Giles, Oxford.*

271 1890. May. ‡Simpson, John, 56, *Chapel Street, Aberdeen.*

527 1892. Feb. ‡Simpson, R. D. J., *Knott Street, Deptford, S.E.*

456 1891. Nov. Sinclair, Prof. William A., M.D., A.M., *Howard University, Washington D.C., U.S.A.*

512 1892. Feb. ‡Slater, Herbert, 24, *Bond Street, Leeds.*

356 1891. Feb. ‡Small, Walter Herbert, *Station Road, St. Dunstans, Canterbury.*

651 1892. Oct. ‡Smith, Fred. William, 92, *St. Leonard Gate, Lancaster.*

502 1892. Feb. ‡Smith, George, 6, *Henry Street, St. John's Wood, N.W.*

79 1888. Oct. ‡Smith, George Allen, *Vestry Hall, Hampstead, N.W.*

685 1893. Feb. ‡Smith, Hamilton, 1, *Oxford Road, Putney, S.W.*

794 1893. July. ‡Smith, Henry J., 91, *Malvern Road, West Kilburn, N.W.*

552 1892. Apr. ‡Smith, Joseph Chas., 28, *Livingstone Place, Rounahay Road, Leeds.*

306 1890. June. ‡Smith, Joseph Sidney, 73, *Elm Park, Brixton Hill, S.W.*

752 1893. May. ‡Smith, Joseph Weedy, 8, *St. James Road, Carlisle, Cumberland.*

587 1892. May. ‡Smith, Percy A., 474, *New Cross Road, S.E.*

597 1892. June. ‡Smith, Richard, Jun., *Salterns Rd., Parkstone, Dorset.*

338 1890. Nov. Smith, Sydney, *Dorset Cottage, Hastings Road, Bexhill.*

416 1891. June. ‡Smith, Warren B., 66, *College Street, Chelsea, S.W.*

298 1890. June. ‡Smith, W. H., 60, *Alma Vale Road, Clifton, Bristol.*

778 1893. June. ‡Smith, William, *Preston, The Hyde, N.W.*

634 1892. Sept. ‡Smithies, Arthur, *Local Board, Castleford, Yorkshire.*

80 1888. Oct. ‡Soper, Henry Charles, 108, *Park Street, Camden Town, N.W.*

95 1888. Oct. ‡Sortwell, W., 14, *Retreat Place, Paragon Road, Hackney, E.*

Reg. No.	Date of Election.	
669	1893. Jan.	‡SOUTER, Charles, *Kingsnorth House, West Malling, Kent.*
81	1888. Oct.	SOUTHPORT, The Mayor and Corporation of, *Southport.*
352	1891. Feb.	‡SPENCER, Julius, 6, *Lord Street, Keighley.*
795	1893. July.	‡SQUIRRELL, Henry T., 5, *Station Road, Bexhill, Sussex.*
82	1888. Oct.	‡STANLEY, A. W., *Newington, Hull.*
540	1892. Mar.	‡STANSFELD, Alfred, 2, *Tokenhouse Buildings, E.C.*
804	1893. Oct.	STAR, William Frost, 143, *Brixton Road, S.W.*
83	1888. Oct.	‡STEERS, George, 21, *Brereton Road, Bedford.*
84	1888. Oct.	‡STEVENSON, John, *Surveyor's Office, East Molesey, Surrey.*
583	1892. May.	‡STEWART, James, 28, *Crozier Street, Westminster Bridge Road, S.E.*
652	1892. Oct.	‡STEWART, Robert Tomlinson, *Thorpe-le-Soken, Essex.*
822	1893. Nov.	‡STEWART, T. D., *Sanitary Inspector, Cupar Fife, N.B.*
369	1891. Feb.	‡STOLLERY, William, *Dust Depôt, Culvert Road, Battersea, S.W.*
796	1893. July.	‡STONE, Alfred William, *Glenview, Long Ashton, Clifton, Bristol.*
827	1893. Dec.	‡STRATHON, William Henry, 3, *Auburn Place, Plymouth.*
823	1893. Nov.	‡STREAT, John, *Ottery St. Mary, Devon.*
174	1889. Apr.	‡STRUTT, Thomas Frederick, 5, *Tavistock Street, Covent Garden, W.C.*
662	1892. Nov.	‡SURTEES, Richard Thos., 29, *Old Gate Street, Morpeth, Northumberland.*
487	1892. Jan.	‡SUTCLIFFE, Alfred, *Featherstone Local Board, Pontefract.*
238	1890. Feb.	‡SUTHERLAND, Walter, 8, *Voelas Street, Liverpool.*
324	1890. Nov.	‡SUTTLE, Alfred, *Manor Square, Otley.*
824	1893. Nov.	‡SWIRE, Henry, 30, *Sheep Street, Skipton, Yorkshire.*
481	1891. Dec.	‡SWITZER, Sidney A., 3, *Mareham Road, Horncastle, Lincolnshire.*
325	1890. Nov.	‡SYDENHAM, Sydney, 37, *Broad Street, Bath.*
786	1893. July.	‡SYKES, Miss Edith Elizabeth, *Woodleigh, East Dulwich Grove, S.E.*
140	1889. Jan.	‡TAIT, James, *Roslyn Place, Dean Street, Kilmarnock.*
127	1889. Jan.	‡TATE, William, 29, *Kenilworth Road, Kilburn, N.W.*
405	1891. June.	‡TAYLOR, Albert, *Vestry Hall, Mount Street, W.*
659	1892. Nov.	‡TAYLOR, Harry James, *Sturminster Newton, Dorset.*
472	1891. Nov.	‡TAYLOR, Harry William, *Surveyor's Office, Newburn-on-Tyne.*
321	1890. Nov.	‡TAYLOR, Henry Thomas, 7, *Wilton Road, Rock Ferry, Cheshire.*
128	1889. Jan.	‡TAYLOR, James, 17, *Oxford Street, Hereford.*
278	1890. May.	‡TAYLOR, James, 10, *Mount Pleasant, Waterloo, Liverpool.*

Reg. No. Date of Election.

539 1892. Mar. ‡Thatcher, Albert George Hendy, *Hampton Court Palace, W.*

718 1893. Apr. ‡Thomas, Charles L., 30, *Berkely Place, Clifton, Bristol.*

279 1890. May. ‡Thomas, George, 17, *de Beauvoir Square, de Beauvoir Town, N., and City of London Electric Lighting and Engineering Office, Portland House, Basinghall Street, E.C.*

86 1888. Oct. ‡Thomas, Thomas, 4, *Chandos Road, Redlands, Bristol.*

85 1888. Oct. ‡Thomas, W. K., 42, 43 & 44, *Triangle, Clifton, Bristol.*

316 1890. Oct. Thompson, Bernard H., 28, *St. Mark's Terrace, New Brompton, Kent.*

693 1893. Feb. ‡Thornton, Richard, *Sanitary Inspector, Kuton, Staffordshire.*

156 1889. Feb. ‡Thorpe, James, 19, *King Edward Street, Macclesfield.*

547 1892. Mar. ‡Titmuss, Joseph E., 31, *Trinity Road, Wood Green, N.*

296 1890. June. ‡Tomkins, Alfred, 62, *Church Street, Camberwell, S.E.*

452 1891. Nov. ‡Tomkys, F. L., *Yeovil, Somerset.*

536 1892. Mar. Travis, David, *Chief Sanitary Inspector, Halifax.*

322 1890. Nov. ‡Trigg, Henry John, 6, *Palmerston Road, Hayling Island, Hants.*

436 1891. July. ‡Trowsdale, Tom James, 12, *Leybourne Terrace, Stockton-on-Tees.*

87 1888. Oct. Tuckey, George F., 47, *Milk Street, Bristol.*

699 1893. Feb. ‡Tuffee, William, Junr., 50, *Parrock Street, Gravesend, Kent.*

305 1890. June. ‡Turner, Alfred, 49, *Ellora Road. Streatham, S.E.*

746 1893. May. ‡Turner, Frederic Richard, *The Plough Inn, Tewkesbury.*

378 1891. Mar. ‡Twaits, James, 25, *Leopold Street, Burdett Road, Mile End, E.*

343 1890. Dec. Veasey, Thomas Frederick, assoc.m.inst.c.e., *care of O. H. Veasey, Bridge House, Huntingdon.*

779 1893. June. ‡Vest, Theodore, 75, *Queen's Park Road, Brighton, Sussex.*

383 1891. Mar. ‡Waddington, Thos. W., 8, *Albert Street, Padiham.*

711 1893. Feb. ‡Wadmore, Alice, 15, *Fairfax Road, South Hampstead, N.W.*

828 1893. Dec. ‡Wagstaff, William Henry, 16, *Mapperley Road, Nottingham.*

712 1893. Feb. ‡Wake, Richard, 619, *Wandsworth Road, Clapham, S.W.*

626 1892. Sept. ‡Wall, Samuel Edward, a.r.i.b.a., 26, *Mount View Road, Stroud Green, N.*

88 1888. Oct. Wallace, Miss J., 6, *Hyde Park Gardens, W.*

215 1889. Nov. Wallas, Irwin Clarke, 41, *Cavendish Road, Clapham Common, S.W.*

Reg. No.	Date of Election.	
682	1893. Feb.	‡Wallis, William, 13, *Gilbert Road, Kennington, S.E.*
696	1893. Feb.	‡Wane, William, 26, *Manchester Street, Southampton.*
273	1890. May.	‡Wansbrough, Cecil Shartman, *Arlington Villa, Barrow-in-Furness.*
564	1892. May.	‡Warran, William Ernest, 5, *Broad Park Villas, Whitchurch Road, Tavistock.*
677	1893. Jan.	‡Warren, William Thomas, *Sanitary Inspector's Office, Vestry Hall, Chiswick, S.W.*
489	1892. Jan.	‡Watson, Harry John James, 5, *Upper John St., W.*
531	1892. Mar.	‡Watson, Thomas, *Kirkoswald, Cumberland.*
492	1892. Jan.	Watson, William Hill, *Vestry Hall, Piccadilly, W.*
98	1888. Nov.	Watts, George Nelson, 147, *High Street, Notting Hill, W.*
232	1890. Jan.	‡Watts, Gerald, 44, *London Road, Grays, Essex.*
216	1890. Feb.	‡Watts, William Frederick, *Bitterne, Southampton.*
571	1892. May.	‡Weatheritt, James, *Town Hall, Newcastle-upon-Tyne.*
89	1888. Oct.	‡Webb, James A., *Town Hall, Fulham, S.W.*
825	1893. Nov.	‡Webster, John William, 3, *Lanhill Road, Paddington, W.*
318	1890. Nov.	‡Weeks, Alfred James, *Clovelly, The Grove, Earlsfield Road, Wandsworth, S.W.*
90	1888. Oct.	‡Wells, G. F., 37, *Prospect Street, Hull.*
576	1892. May.	‡Wells, William James, *Lower Kingswood, Reigate.*
595	1892. June.	‡White, William, 27, *Harvey Street, Folkestone.*
755	1893. May.	‡White, William L., *New Street, Upton-on-Severn, Worcester.*
371	1891. Feb.	‡White, William Owen, 8, *Albert Street, Banbury.*
508	1892. Feb.	‡Whitham, Joseph, *Shelf, Halifax.*
413	1891. June.	‡Whittome, Philip Alfred, *The Chestnuts, Rothesay Road, Bedford.*
541	1892. Mar.	‡Wilkinson, George H., 83, *Townsend Lane, Anfield, Liverpool.*
91	1888. Oct.	‡Wilkinson, W., *Ford Street, Derby.*
574	1892. May.	Wilkinson, William, *Altofts, Normanton.*
754	1893. May.	Wilks, Henry, *Bramham, Boston Spa, Yorkshire.*
320	1890. Nov.	‡Willbond, George Baines, *Guildhall, Nottingham.*
642	1892. Oct.	‡Williams, George, 6, *Priory Road, Everton, Liverpool.*
498	1892. Feb.	‡Williams, Joseph, 30, *Goldhurst Terrace, Finchley Road, N.W.*
545	1892. Mar.	‡Williams, Richard Jun., *Little Woolton Local Board, Gateacre, Liverpool.*
162	1889. Mar.	‡Wilson, Charles Turle, 37, *Burney Street, Greenwich, S.E.*
198	1889. June.	‡Wilson, John, *Town Hall, Kensington, W.*
206	1889. July.	‡Wilson, William, 5, *Windsor Terrace, South Shields.*
641	1892. Oct.	‡Windsor, William, 13, *Sutcliffe Street, Liverpool, E.*
92	1888. Oct.	‡Winser, F. Sawyer, 52, *Buckingham Palace Road, S.W.*

Reg. No.	Date of Election.	
602	1892. June.	‡WINSBORROW, Edwin James, *Town Hall, Westminster, S.W.*
175	1889. Apr.	‡WINTER, Edward, 82, *Church Road, Hove, Brighton.*
657	1892. Nov.	‡WOOD, Alfred, *Bury, Lancashire.*
411	1891. July.	‡WOOD, Charles Bruce, 37, *Irene Road, Parsons Green, S.W.*
600	1892. June.	‡WOOD, Charles Fred, 1, *Cedar Villas, W. Hampstead, N.W.*
131	1889. Jan.	‡WOOD, Peter, 177, *Ashmore Road, Paddington, W.*
209	1889. July.	WOODCOCK, Henry, 16, *Steelhouse Lane, Birmingham.*
451	1891. Nov.	‡WOODESON, William, 1A, *Charles Street, Pendleton, Manchester.*
665	1893. Jan.	‡WOODHEAD, Fletcher, 56, *Gordon Street, Burnley.*
514	1892. Feb.	‡WOODMAN, Henry Frederick, 41, *Glengall Road, Kilburn, N.W.*
687	1893. Feb.	‡WOOLNOUGH, Tom, *Northolme, Aberdeen Road, Highbury, N.*
678	1893. Jan.	‡WRIGHT, John Henry, Junr., 2, *Grosvenor Place, Bexley Heath, Kent.*
132	1889. Jan.	‡WRIGHT, John, Junr., 3, *Surbiton Park Terrace, Kingston-on-Thames.*
805	1893. Oct.	‡WRIGHT, Samuel William, 17, *Melville Road, Ford, Devonport.*
504	1892. Feb.	‡YATES, Robert, 42, *Lupus Street, St. George's Sq., S.W.*
491	1892. Jan.	‡YOUNG, Frank Russell, 60, *Elmsdale Road, Walthamstow, Essex.*
532	1892. Mar.	‡YOUNG, Isaac, 39, *Dorothy Road, Lavender Hill, S.W.*

NOTE.—It is particularly requested that the Secretary may be informed, *in writing*, of every decease and change of address; also of any errors or omissions that occur in the list of members.

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STRATHON, William Henry.
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WARRAN, William Ernest.
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DOWSING, Alfred.
JEVONS, John H.
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LEWIS, Charles.
MASON, Jonathan.
MAXWELL, William Henry.
ROW, Edmund.
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WATTS, Gerald.
YOUNG, Frank Russell.

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MALVERN, Thomas.
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SIMMONS, Nimrod.
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STONE, Alfred William.
THOMAS, Charles L.
THOMAS, Thomas.
THOMAS, W. K.
TUCKEY, George F.
TURNER, Frederick Richard.

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White, William, F.S.A., F.R.I.B.A.
Wightwick, Fallon Percy, M.B., M.R.C.S., L.R.C.P., D.P.H.
Williams, C. Theodore, M.A., M.D., F.R.C.P., F.R.MET.SOC.
Wood, Jacob.
Wood, William, M.D.
Worth, John Edward, ASSOC.M.INST.C.E., F.R.MET.SOC.
Wyndham, Rev. Francis M., M.A.OXON.
Yuill, W., ASSOC.M.INST.C.E.

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Adams, H. J.
Adams, Miss Rose.
Allan, George Awburn, Jun.
Andrews, Daniel James.
Annett, William Fenn.
Anthony, Frederick Joseph.
Armstrong, Joseph.
Ashdown, Thomas.
Ashley, Sydney.
Athey, Frederick.
Atkins, Robert William.
Ayliffe, Charles William Loveless.
Barfoot, James.
Barrett, Henry James.
Barth, Frederick Alfred.
Bartlett, William John.
Barron, John.
Bassett, William Joshua.
Baxter, Frank E.
Baxter, John.
Bennett, Edward.
Birch, John Ernest William.
Blake, E. T., M.D.
Blake, H. K.
Blay, Ernest Berrenger.
Bone, William Homersham.
Boyce, W.
Boyd, Richard Wade.
Bridel, H. F.
Broad, Clement B.
Brown, Robert, Jun.
Bryan, George John.
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CATTEN, Joseph H.
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CHAPPELL, William.
CHESTERFIELD, William James.
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CLARK, John Edwin.
CLARKE, Robert Edwyn.
CLIFTON, Henry Charles.
COCKBURN, Henry Mace.
COOK, Alfred.
COOK, William Gough.
CORP, James.
COWPER, Joseph.
COXILL, George E.
CRANE, Stephen.
CRONK, William Robert.
CROSSE, Hammond William.
CULVER, Thomas Henry.
DAVIES, T. Lane.
DAVIS, John Edward.
DEE, Thomas George.
DENSHAM, Charles A.
DOCKING, Frederick Reynolds.
DOVER, John Henry.
DUNN, James Stephen.
DYKE, Alfred William.
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EDWARDS, John.
ELMS, Thomas Hood.
EVANS, John Evan.
EVANS, Percival Baker.
FAIRCHILD, Samuel C. G.
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FEW, Herbert Arthur.
FISHER, Robert.
FOAD, Cephas.
FOLLAND, John Percy.
FORDHAM, William Francis.
FRENCH, Harry Cramphorn.
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GEARY, Reginald.
GENTRY, Herbert John.
GILBEART, John Joseph.
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GOODMAN, Herbert.
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GOUGH, Joseph.
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HEAD, Robert H.
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HILLYARD, Henry.
HOOPER, Thomas Henry.
HOOPER, William.
HORTON, Richard.
HORTON, William.
HOUGHTON, Robert Alfred.
JARRATT, Edward John.
JELLIS, John.
JOHNSON, John William.
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JONES, Julius Morris Wilson.
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PHILLIPS, Charles.
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HORNER, Benjamin Roper.
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LOWRY, James.
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GOODWYNN, Arthur Ayde.
HOOPER, Thomas Rowland.
HORNCASTLE, Henry.
INGRAM, William Jones.
KEAL, J.

SURREY—*Continued.*

LIGHTFOOT, Thomas.
MAYNE, John William.
NORRIS, Joseph.
PEARCE, Frederick James.
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HEAD, Mrs. H.
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GRANT, Ernest Henry.
GRANT, Walter.
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PATCHING, William George.
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DAVIES, Dan.
DAVIES, Edward Plummer.
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JOHNS, David James.
JONES, William.
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FRANCE, T. W. Chapman.
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ARMITAGE, Thomas Albert.
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BROWN, R. Railston.
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CLARKSON, Joseph.
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GOING, Joseph A., M.R.C.S., B.A., M.O.H.
IVOR-MOORE, T.
LOWE, Louis J. McKenzie, M.INST.C.E.
MELISSENOS, G. C. A. Melisurgo, ASSOC. M.INST.C.E.
MITCHELL, Robert.
MORRIS, Griffith John, R.E.
SIMPSON, Wm. John, M.D., D.P.H.CAMB.
SIORDET, James Lewis, M.B., F.R.C.P.
STANBURY, W. H.
SWINNERTON, Robert Allen William, ASSOC.M.INST.C.E.
TAYLOR, Wm. Frederick, M.D., M.R.C.S., L.S.A., D.P.H.
WILLIAMS, Roscoe A., M.D.

Associates:—

ATTRIDGE, Henry L.
HALE, Alexander.
HALLIGAN, William.
HEARNE, William.
SINCLAIR, Prof. William A., M.D., A.M.

ADDRESS NOT KNOWN.

Fellow:—

ELLIS, W. Horton, F.R.MET.S.

Member:—

BOX, M. H.

Associates:—

GRIBBLE, Miss Sarah C.
LENNOX-CLARKE, A.

THE SANITARY INSTITUTE.

FOUNDED 1876. INCORPORATED 1888.

ILLUSTRATED LIST OF EXHIBITS

TO WHICH

MEDALS AND CERTIFICATES HAVE BEEN AWARDED

AT THEIR EXHIBITIONS,

HELD IN

CONNECTION WITH THE CONGRESSES

AT

WORCESTER, 1889.

BRIGHTON, 1890.

PORTSMOUTH, 1892.

1894.

London:

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KENNY & CO., PRINTERS,
25, CAMDEN ROAD, CAMDEN TOWN ,LONDON, N.W

THE SANITARY INSTITUTE.

ILLUSTRATED LIST OF EXHIBITS TO WHICH MEDALS AND CERTIFICATES HAVE BEEN AWARDED AT THE EXHIBITIONS HELD IN CONNECTION WITH THE ANNUAL CONGRESS.

JUDGES OF THE EXHIBITIONS.

ERNEST TURNER, F.R.I.B.A., *Chairman.*
R. W. PEREGRINE BIRCH, M.INST.C.E.
PROF. A. WYNTER BLYTH, M.R.C.S., L.S.A.
PROF. W. H. CORFIELD, M.A., M.D.
THOMAS W. CUTLER, F.R.I.B.A.
ROGERS FIELD, M.INST.C.E.
BALDWIN LATHAM, M.INST.C.E.
HENRY LAW, M.INST.C.E.
ARTHUR NEWSHOLME, M.D., D.P.H.
LOUIS PARKES, M.D., D.P.H.

PREFACE.

This Illustrated List has been published by the Institute in the belief that it will be a useful guide to Professional Men and to the Public in the selection of Appliances and Articles included in the extensive scope of these Sanitary and Domestic Exhibitions.

Most of the new improvements and recent developments in Sanitary matters have been brought forward at the Exhibitions which have been held nearly every year since 1877. The present List refers only to the Awards made since the Incorporation of the Institute in 1888, but a classified List (not illustrated) of the whole

of the objects to which Awards have been given previously to 1888 can be obtained from the Secretary.

The Institute has, by inaugurating a carefully devised system of judging, endeavoured to avoid the unreliability which so often attaches to Awards given at Public Exhibitions.

In the first place, uniformity in the principle upon which the Awards have been based is ensured, as far as possible, by giving stability to the Court of Judges—that is to say, that while gradual changes are made in the personnel of the judges, the larger number remain in office for several years. This method, of course, also gradually forms a very experienced body of judges.

In the next place the Institute has always been careful that the Board of Judges shall be composed of men of different professions—Engineers and Architects, as well as Medical Officers of Health and Chemists.

Lastly, the judges have laid it down as a guiding principle that the Awards are to be made primarily in the interests of the Public, and that the great point to be aimed at is to afford a trustworthy Guide to the Public as to what is good and reliable amongst the Sanitary Appliances and other Exhibits which have come before the judges. In order to effect this object no Award is, as a rule, given to any Exhibit unless some of the judges know by their own experience that it is of value, or unless it has been subjected to special practical tests carried out at the time of the Exhibition or subsequently.

CONTENTS AND CLASSIFICATION OF THE EXHIBITIONS.

DIVISION A.—SCIENCE IN RELATION TO HYGIENE.

DIVISION B.—HYGIENE OF SPECIAL CLASSES, TRADES AND PROFESSIONS.

DIVISION C.—CONSTRUCTION AND SANITARY APPARATUS.

CLASS I.—Building Materials, Construction and Machinery.

DIVISION C.—*Continued.*

CLASS II.—Water Supply and Sewerage.

CLASS III.—Heating, Lighting and Ventilating.

DIVISION D.—PERSONAL & DOMESTIC HYGIENE.

ILLUSTRATED LIST OF EXHIBITS

TO WHICH MEDALS AND CERTIFICATES HAVE BEEN AWARDED AT THE EXHIBITIONS

HELD IN CONNECTION WITH THE

ANNUAL CONGRESSES.

In the following pages all the Exhibits for which Awards were given at the Exhibitions at Worcester, Brighton, and Portsmouth are mentioned, but in many cases it is obviously unnecessary, for practical purposes, to insert an Illustration, and in these cases the description or name only of Exhibits are given.

DIVISION A.—SCIENCE IN RELATION TO HYGIENE.

DIVISION A.—Section 6. Medicine (Preventive).

Sanitary Publications.

Medal, 1890.

To W. H. Allen & Co., 13, Waterloo Place, S.W.

DIVISION A.—Section 7. Meteorology.

American Forecast Barometer.

Certificate of Merit, 1892.

To Joseph Davis & Co.

Description.—The Instrument is made in oak or walnut frame and has a large column of mercury, having on each side an index and pointer; the index next the tube registers the height of the mercury. The long hand or pointer moving with it enables a reading to be taken without the use of a vernier. It also "forecasts" the approaching weather. On the right side of the dial predicting for summer, and on the left for winter. The larger letters in each division indicating the most probable weather. The dial has an aluminium surface. A floating compass is fixed in the base of the Instrument.

Size.—41 in × 12 in.

Price.—£4 4s.

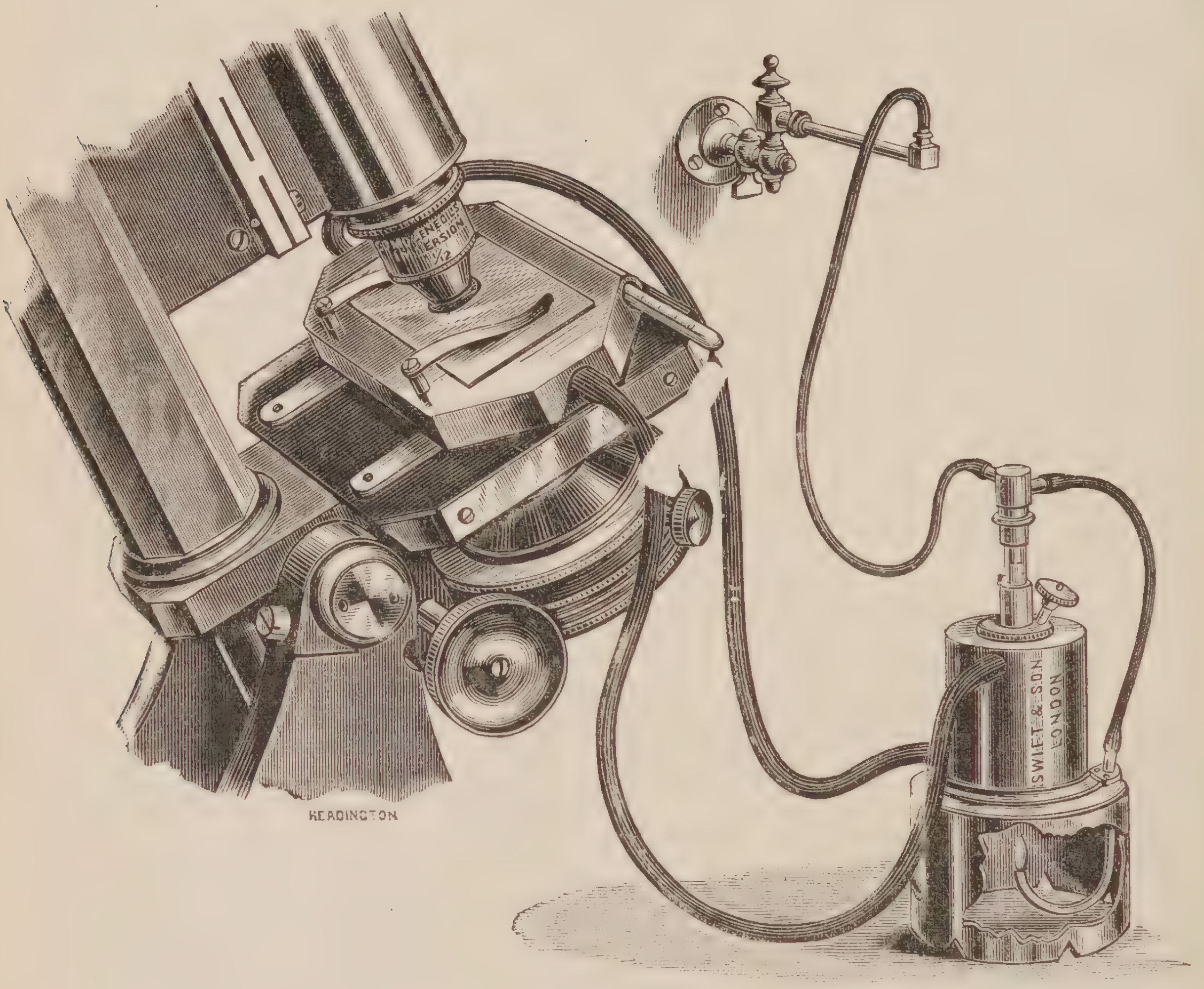
Manufactured by Joseph Davis & Co., 6, Kennington Park Road, S.E.

DIVISION A.—Section 8. Microscopy.

Microscopic Apparatus.

Medal, 1890.

To J. Swift & Son.



Description. — Professor Schafer's Hot-water Circulation Stage can be readily adapted with a Regulator for maintaining even temperature for any length of time. This Stage is made so that the Abbe Condenser can be used in conjunction with it.

Price.—£3.

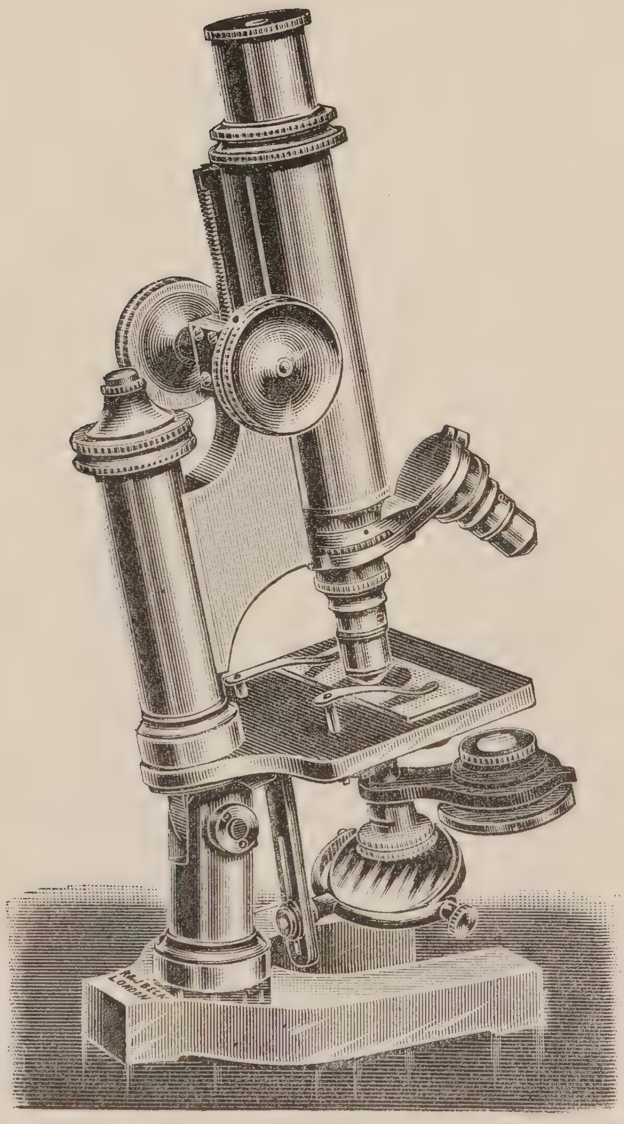
Manufactured by James Swift & Son, Tottenham Court Road, W.

DIVISION A.—Section 8. *(Continued.)*

Improved Continental Microscope.

Medal, 1892.

To R. & J. Beck.



Description.—The Improved Continental Microscope Stand, with rack and pinion, coarse adjustment, fine adjustment by screw; double mirror on sliding bar; complete substage with focussing and swinging adjustments; Abbé condenser and iris diaphragm; two eye-pieces; two object glasses $\frac{2}{3}$ in. and $\frac{1}{6}$ in. In strong case, handle, and lock.

Price.—£8 15s.

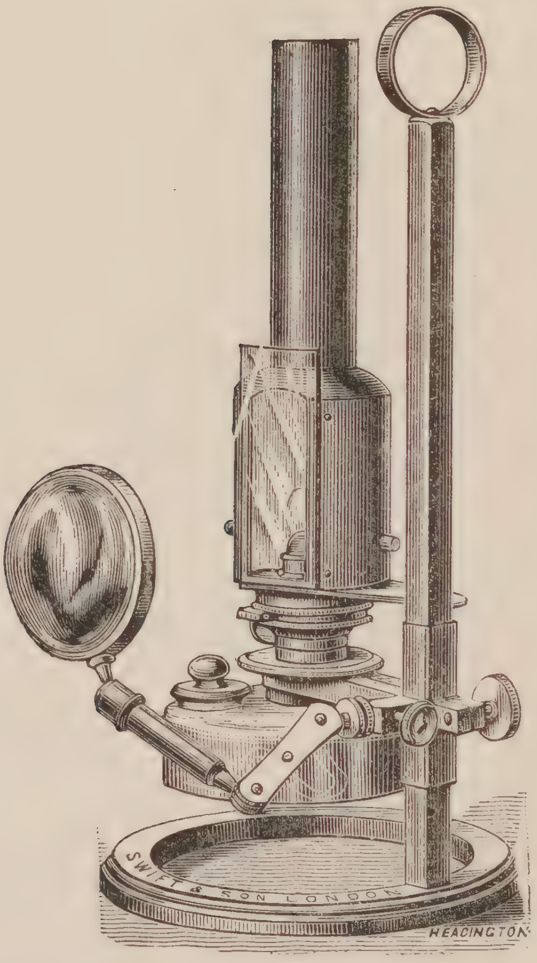
Manufactured by R. & J. Beck, 68, Cornhill, E.C.

DIVISION A.—**Section 8.** *(Continued.)*

Microscope Lamp.

Medal, 1892.

To J. Swift & Son.



Description.—Designed for direct illumination without the use of the mirror, the flat container enabling it to go very low down, which moves in an arc equal to 90 in., so that either the flat side or the edge of the flame may be used. Revolving metal chimney, which takes the ordinary 3 in. × 1 in. glass slip bull's-eye condenser, can be supplied at an extra cost of 12s.

Price.—£2 10s. The same lamp, with ordinary glass chimney and shade, £1 3s. Polished Pine Case, 4s. extra.

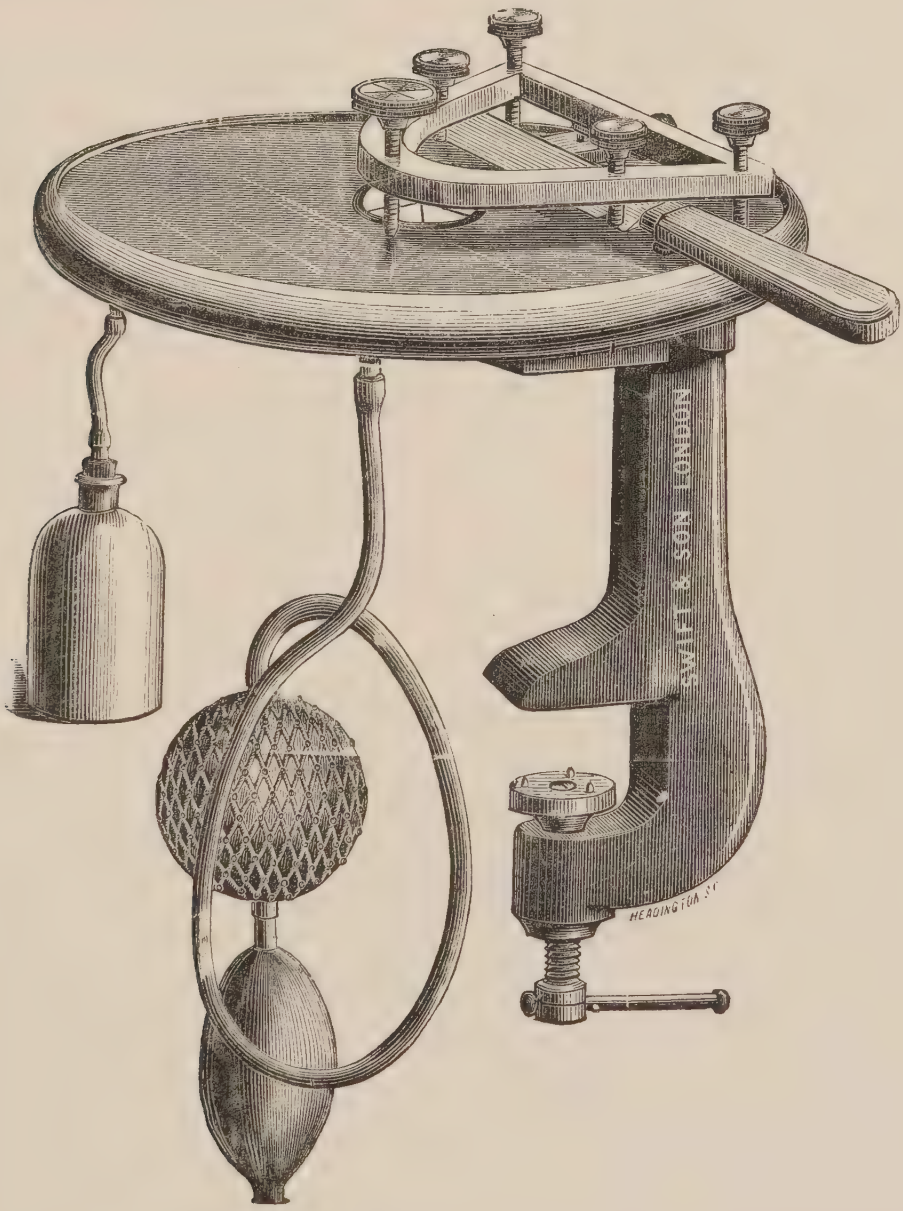
Manufactured by James Swift & Son, Tottenham Court Road, W.

DIVISION A.—**Section 8.** *(Continued.)*

Groves' Modification of Williams' Microtome.

Certificate of Merit, 1892.

To J. Swift & Son.



Prices.—Groves' modification of Williams' Microtome, for use with ether spray, £3 3s. A vulcanite chamber can be supplied for freezing with ice and salt at an additional cost of £1.

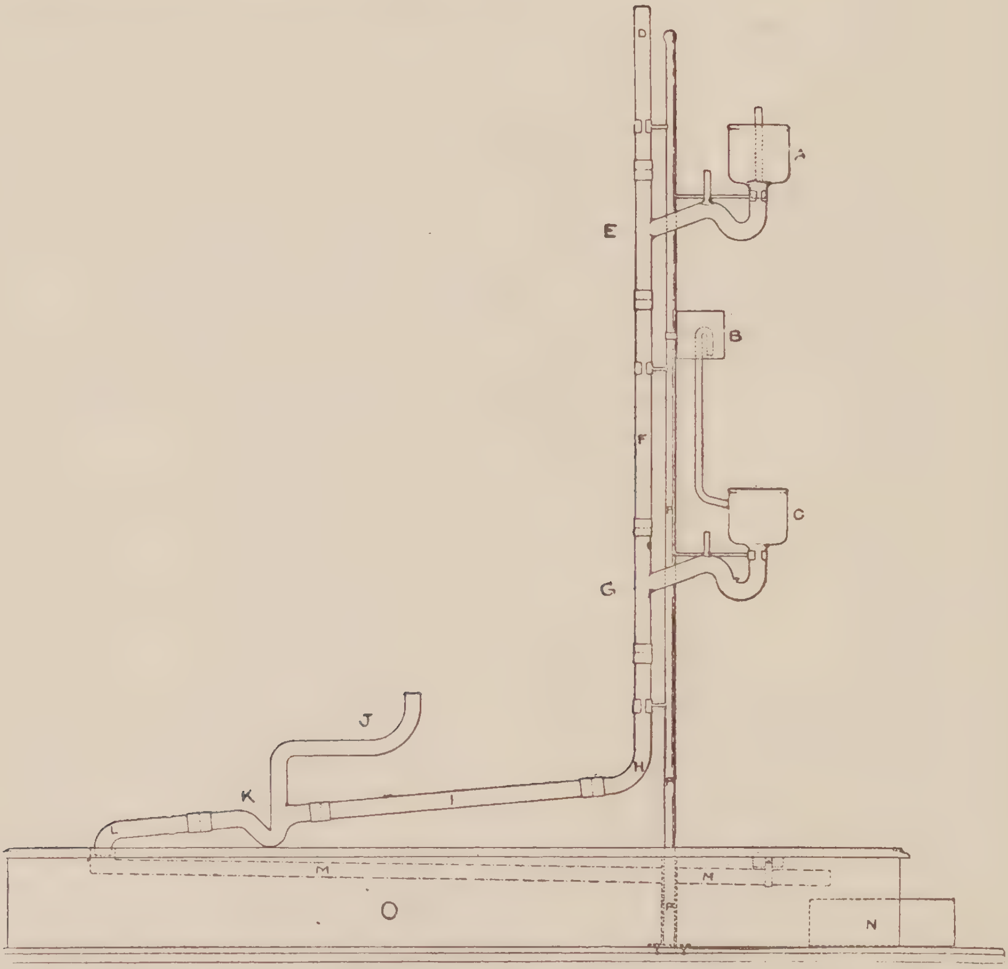
Manufactured by James Swift & Son, Tottenham Court Road, W.

DIVISION A.—Section 9. Physics.

Knight's Demonstration Model Shewing Soil Pipes and Traps.

Certificate of Merit, 1892.

To Portsmouth Water Fittings Co.



A—Valve Closet. B—Siphon Flushing Cistern. C—Wash-down Closet. D—Ventilating Shaft. E—Branch for W.C. F—Soil Pipe. G—Branch for W.C. H—Bend or Foot of S.P. I—Drain. J—Air Shaft. K—Intercepting Trap. L—Drain to Sewer. N—Reservoir. O—Base Box. P—Brass Support.

Description.—The model is made in glass, and designed for the purpose of demonstrating the behaviour of water in drain pipes and traps under various conditions of ventilation and non-ventilation, and illustrates the unsealing of Traps by compression and Siphonic action. The model is supplied in a case, which forms a convenient base for setting up the model.

Price.—£3 3s.

Made by W. H. Knight, "Dulce Domum," Gisburn Road, Hornsey.

DIVISION B.—HYGIENE OF SPECIAL CLASSES, TRADES AND PROFESSIONS.

DIVISION B.—Section 2. Various Trades and Manufactures.

Exhibit of Models of Railway Rolling Stock and Appliances.

Medal, 1890.

To London, Brighton, and South Coast Railway, London.

Specimens of Photography.

Certificate of Merit, 1890.

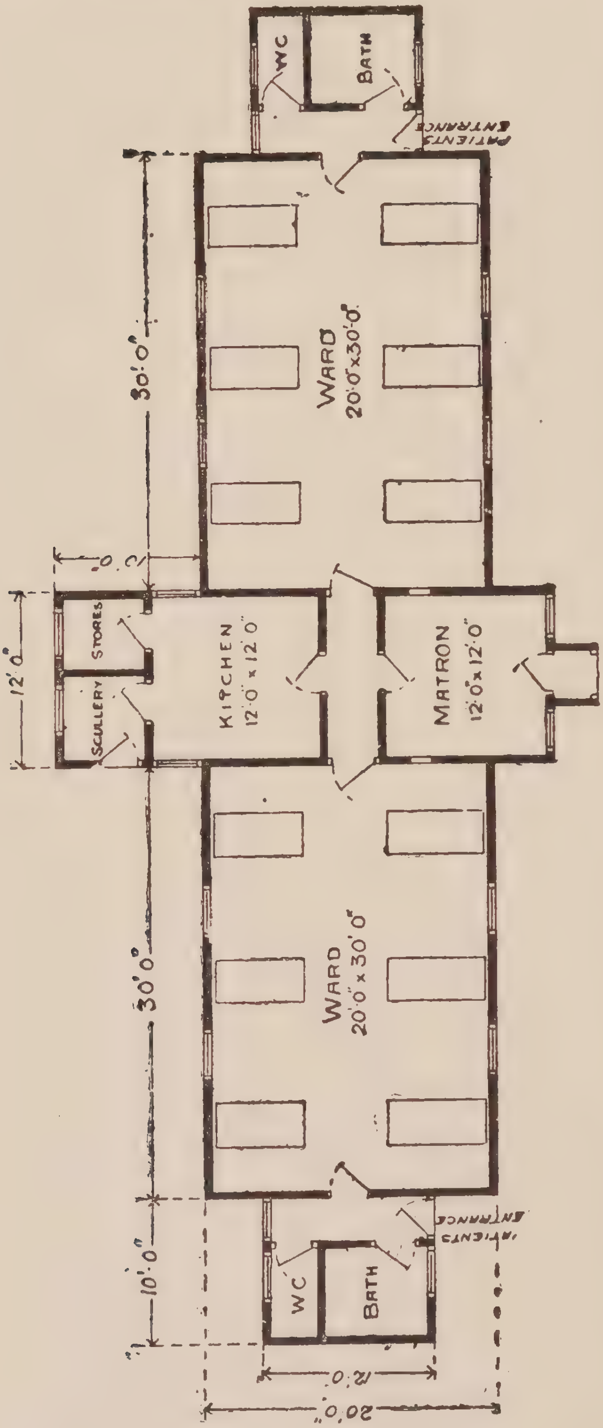
To Burt Sharp, 79, West Street, Brighton.

DIVISION B.—**Section 3. Hospitals.**

Iron Temporary Hospital Hut.

Certificate of Merit, 1892.

To Humphreys, Limited.



Description.—The hospital is made of timber framing, covered with galvanized corrugated iron, and is lined inside with felt and match-board stained and varnished, and is built on the one-storeyed pavilion plan, having the administrative block in the middle and a ward on each side. The further end of each ward opens into a lobby, beyond which are placed the w.c. and bath room. The wards are warmed by an open stove. About half-way up the roof on each side and at a distance of 15 ft. apart Dormer ventilators are inserted, which are provided with perforated zinc plates and "hit and miss" shutters. Inlet tubes similar to those of Tobin's system are provided, and gable ventilators are also fixed in such a manner as to allow the whole of the opening to be used as an air space. Ventilation at the ridge is also provided for. The laundry and mortuary are cottages standing apart from the main building.

Price.—Including Matron's Room, Kitchen, and Offices, 4 beds, £223; 8 beds, £323; 12 beds, £342; 16 beds, £394; 20 beds, £444; 24 beds, £494.

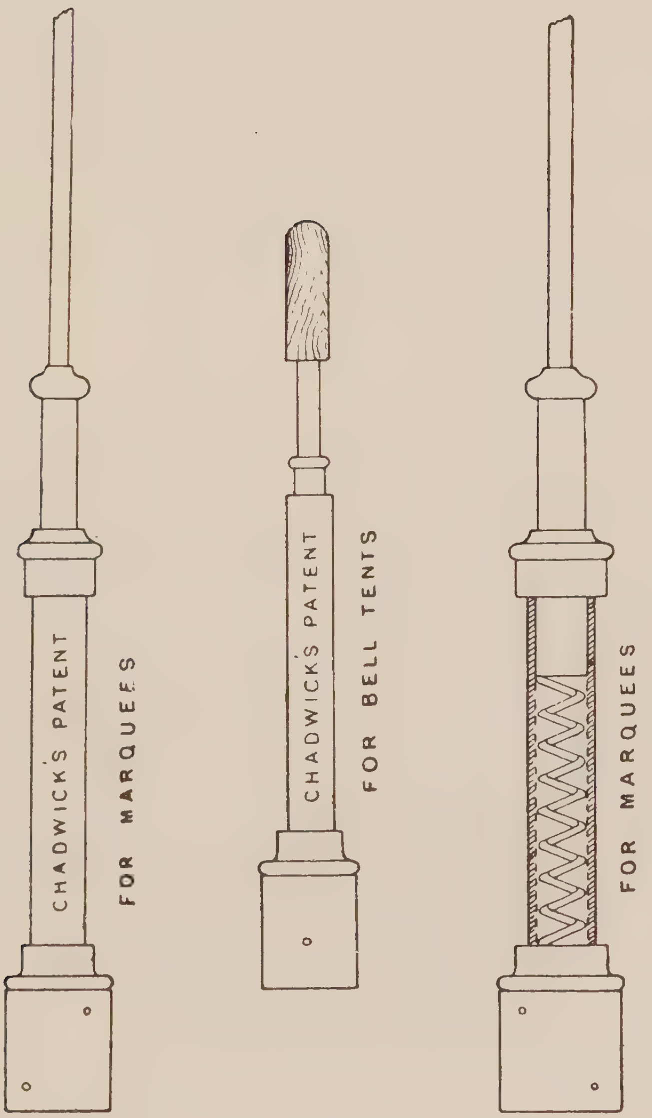
Manufactured by Humphreys, Limited, Iron Building Works, Knightsbridge, Hyde Park, London, S.W.

DIVISION B.—Section 5. Barracks and Camps.

Self-Adjusting Tent Pole.

Certificate of Merit, 1892.

To J. Chadwick.



Description.—The upper part of the Pole is telescoped and bears upon a strong spring, so that the Pole yields by shortening when any exceptional strain is put on the rope, and recovers itself when the strain ceases.

Prices.—From 15s. to £2 10s.

Manufactured by John Chadwick, 32, Victoria Street, Landport, Portsmouth.

DIVISION B.—Section 5. *(Continued.)*

A Square Tent for Garden.

Certificate of Merit, 1892.

To C. Groom & Co.

Size.—10 ft. × 10 ft.

Price.—£9 10s. each.

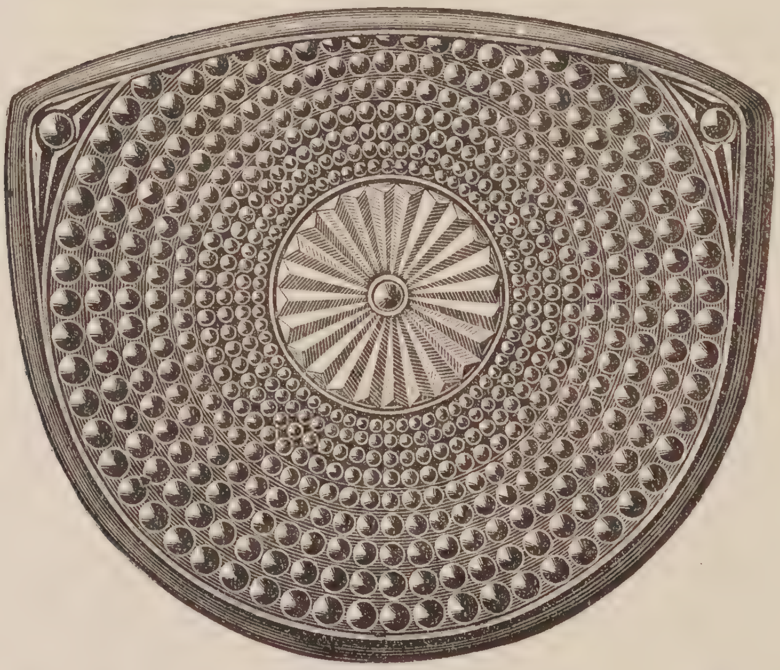
Manufactured by Charles Groom & Co., Broad Street, Portsmouth.

DIVISION B.—Section 11. Prevention of Accidents.

India-Rubber Pad for Carriage Steps.

Certificate of Merit, 1889.

To Henry Wall.



Description.—The Cover is moulded in one piece, and fits on the top of the Step and round the edge, with a lip or flange to secure it. The surface is moulded in the form of small cones, thus affording a secure tread. The Cover is easily adjusted, and may be removed at pleasure.

Sizes.—From 5 in. diameter.

Prices.—From 5s. 6d.

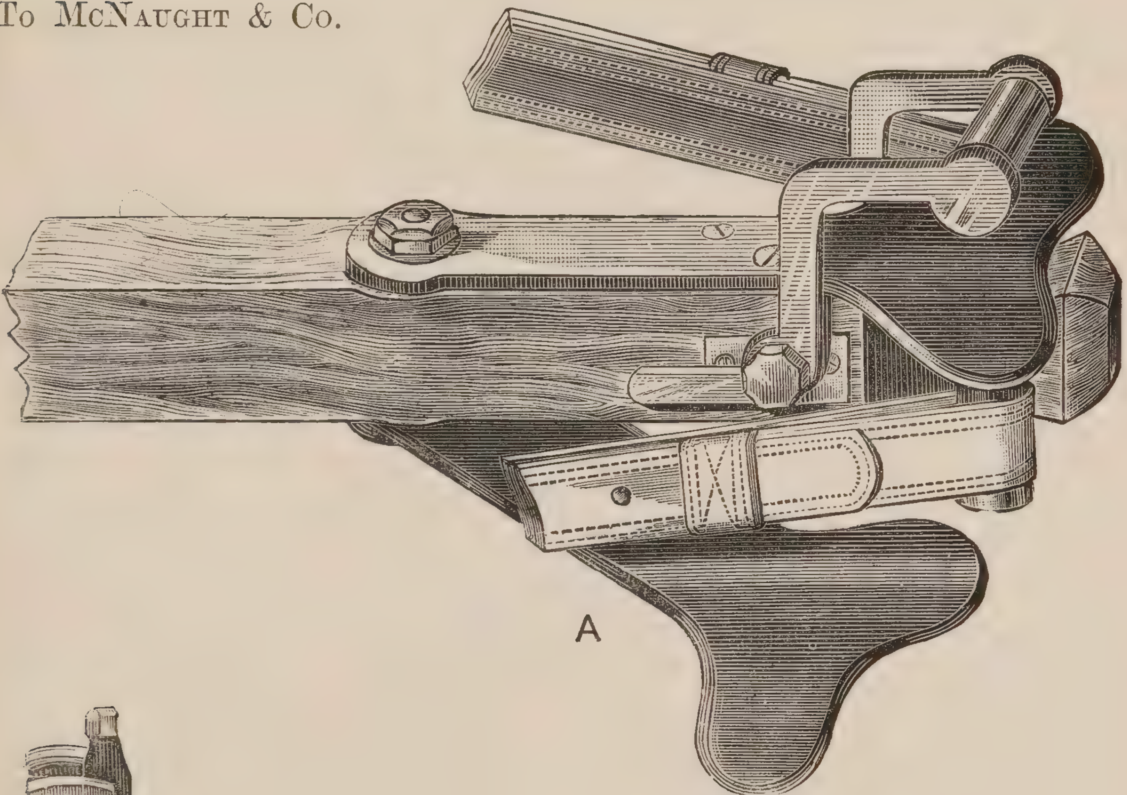
Manufactured by The Birmingham India-Rubber Co., 124, New Street, Birmingham.

DIVISION B.—**Section 11.** *(Continued.)*

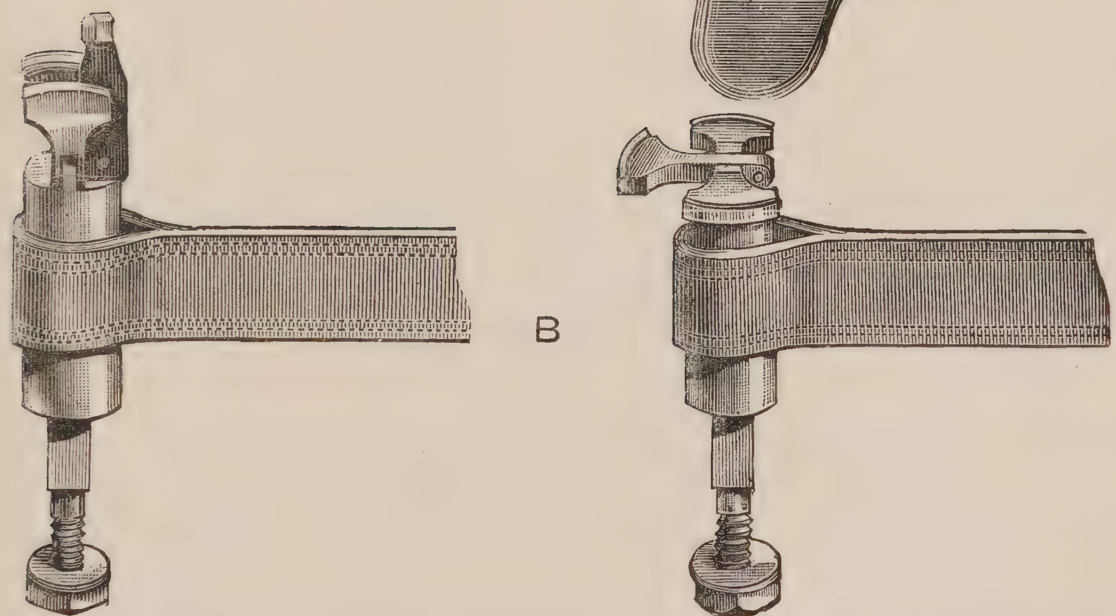
Arrangement for Releasing Horses from Vehicles in cases of Accident.

Certificate of Merit, 1889.

To McNaught & Co.



A



B

Description.—The end of the Carriage-Pole is fitted with two flat Iron Plates, the upper one of which is a fixture, having two Studs upon it pointing downwards, to which the Pole-Chains or Straps are attached; the Under Plate is made to Revolve so that either horse can be set free, as by turning back this Revolving Plate the Pole-Chains or Straps drop off of their own accord. The Plate is kept in its place by means of a small Clamp which grips the Pole on either side of both the Upper and Lower Plates (Fig. A). The Roller Bolt has an invertible head, which, somewhat in the form of a Greek cross when open, can, by a touch of the hand, be inverted, allowing the trace to be instantly slipped off (Fig. B).

Prices.—For Double Harness, per set complete, including fixing, £3 3s.; for Dog Carts, per set complete, including fixing, £1 1s.

Manufactured by McNaught & Co., Worcester, & 10, Park Lane, Lond., W.

DIVISION B.—**Section 12. Prevention of Fires.**

Exhibit of Fire Extinguishing Appliances.

Medal, 1890.

To Brighton Volunteer Fire Brigade.

Hand Chemical Fire Extincteur.

Certificate of Merit, 1890.

To The Haslam Fire Extinguisher Co.

Description.—It is made in a Conical form to allow of a large base for it to stand upon; the Cover is an outside Shell which revolves round the top of the Nozzle, and Locks the same on the Fastenings. The India Rubber Joint Ring is so made that the pressure in the Extincteur forces it against the side of the Nozzle and makes its own joint. The Acid Bottle inside is broken by a Screw-Plunger, the latter being operated by a Handle on the outside; the Discharge-Pipe is carried from the bottom of the Extincteur.

Prices.—From 7s. 6d. to £2; recharges 2s. each.

Manufactured by The Haslam Fire Extincteur Co., Tonge Road, Bolton.

Water Curtain for Public Places of Entertainment.

Certificate of Merit, 1892.

To Portsmouth Water Fittings Co., Portsmouth.

DIVISION C.—CONSTRUCTION AND SANITARY APPARATUS.

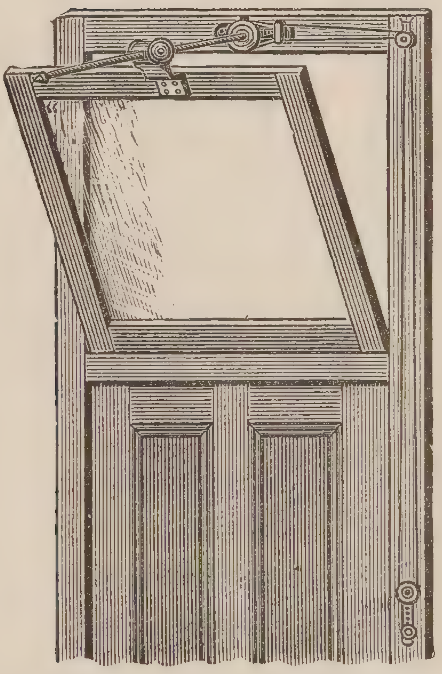
CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

DIVISION C.—CLASS I.—Section 1. Materials and Construction.

"Grahtryx" Secure Fanlight Opener.

Medal, 1889.

To J. WARD & SONS.



DESCRIPTION.—An Endless Cord passing over a Grooved Pulley, and worked by hand, causes the Screw to revolve, thereby opening the Fanlight to the required distance, and locking it at any Angle.

SIZES.—Opening from ½ in. to 20 in.

PRICES.—From 7s. 6d.

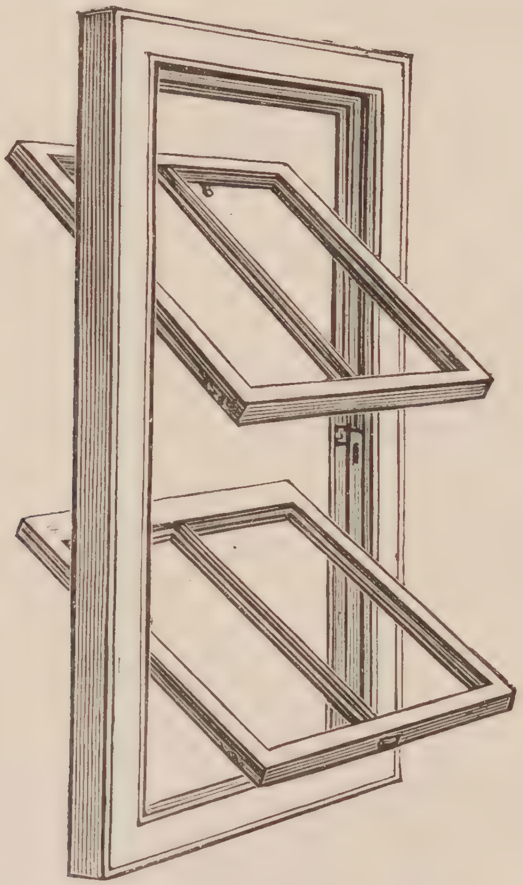
Manufactured by BAIRD, THOMPSON, & Co., Ventilating Engineers, London and Glasgow.

DIVISION C.—CLASS I.—**Section 1.** *(Continued.)*

Millar's Reversible Windows.

Certificate of Merit, 1889.

TO MILLAR'S REVERSIBLE WINDOW CO.



DESCRIPTION.—The outside of each Sash can be reversed into the room and cleaned from the inside, thus avoiding risk of accident. Being self-balanced, they can be opened for the purposes of ventilation, and they can be taken off the stiles altogether and replaced without taking off any of the beads or disturbing the woodwork about the frame. Existing windows can be adapted to this principle.

PRICES.—According to description of Sash, from 15s. per Window opening *extra* over ordinary double hung sashes.

IN PARTS.—Hinged Stiles, 6s. 3d. per Pair; Teak ditto, 8s. 4½d.; or Brass Joints, 3s. 9d. per Pair.

Manufactured by THE REVERSIBLE WINDOW CO., 9, Hart Street, Bloomsbury.

DIVISION C.—CLASS I.—Section 1. *(Continued.)*

Model of Window with removable Sashes to facilitate Cleaning.

Certificate of Merit, 1892.

To A. CARTER.

DESCRIPTION.—The Window Frame and Sashes are made the same as ordinary ones, with the exception that one side of the window frame is fitted with a double pulley stile, the face of which is cut and hinged, so that it can be opened out and forms a recess for sashes to go in, enabling them thus to pass the beads on the opposite side of window frame. It can be applied to existing window frames.

PRICES.—1½ in., 10½d.; 1¾ in., 11d.; 2 in., 11½d. per super foot; with Oak Sills, 1d. per foot extra.

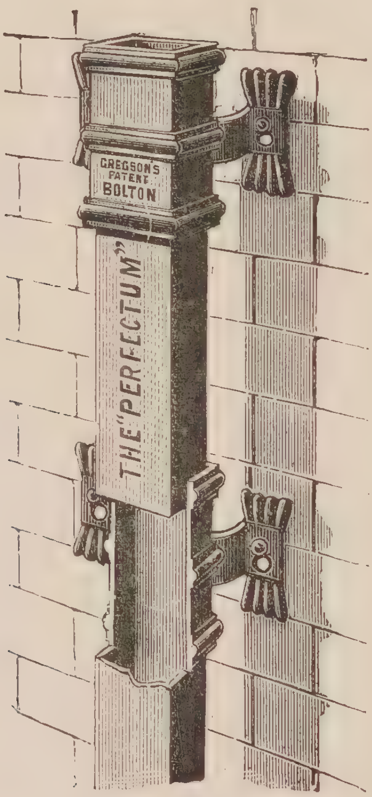
Manufactured by ALFRED CARTER & SON.

DIVISION C.—CLASS I.—**Section 1.** *(Continued.)*

Removable Rain-Water Pipes, Heads, Clips, and Hangers.

Certificate of Merit, 1889.

To JAMES GREGSON.



DESCRIPTION.—These Pipes have Ears with Slotted Nail-holes, so that they can be lifted from the wall, and are made with long Sockets so that the Ears can be adjusted to the joints in the brickwork. The projecting Ears set the Pipe out from the wall so as to allow of painting the back of the Pipes, and to prevent escaping water running down the wall.

SIZES.—3 × 2½ in., 3½ × 2½ in., 4 × 3 in.

PRICES.—3s., 3s. 3d., 3s. 9d. per yard.

Manufactured by JAMES GREGSON, Bath Street, Bolton.

DIVISION C.—CLASS I.—**Section 1.** *(Continued.)*

Wire Wove Roofing.

Certificates of Merit, 1889 and 1890.

To NEW WIRE WOVE ROOFING CO.

DESCRIPTION.—It consists of a fine net-work of woven wire, coated with a translucent waterproof compound. It is of various tints, and although only one-third the weight of ordinary glass will bear more weight.

SIZES.—In sheets 2 ft. and 4 ft. wide, and 5 ft. and 10 ft. in length.

PRICES.—Ordinary quality, 5½d. per square ft.; superfine, 6½d. per square ft.

Manufactured by THE NEW WIRE WOVE ROOFING CO., LIMITED, 75A, Queen Victoria Street, E.C.

Robinson's Cement for Plastering.

Certificate of Merit, 1889.

To J. ROBINSON & CO.

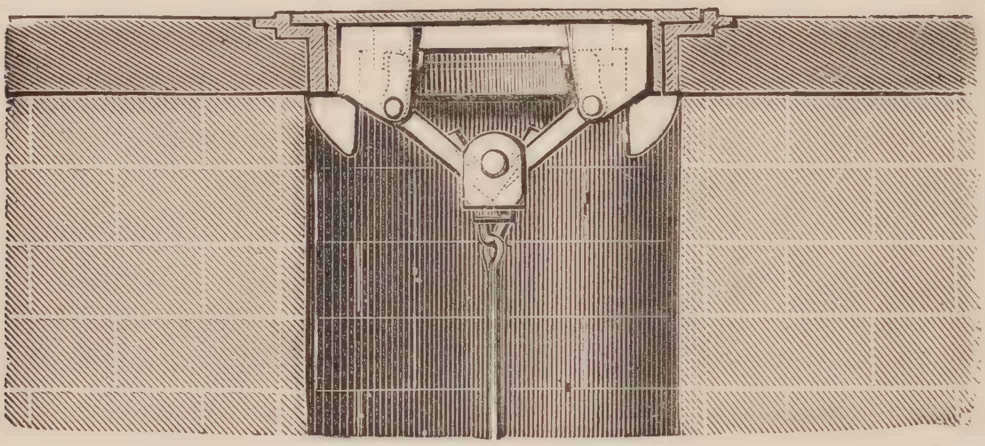
Manufactured by J. ROBINSON & CO., Knothill, near Carlisle.

DIVISION C.—CLASS I.—Section 1. (*Continued.*

Self-Locking Coal Plate.

Medal, 1890.

To HAYWARD BROTHERS & ECKSTEIN.



DESCRIPTION.—It consists of a frame fixed in the pavement, into which the Plate is dropped and secured or locked by projecting bolts on each side, actuated by an arrangement of two small levers with a weight in the centre. The Coal Plate can be pushed out with a stick, or a rod connected to the centre weight.

SIZES.—Outside diameter, 12 in. to 18 in.

PRICE.—6s. to £1 5s.

Manufactured by HAYWARD BROTHERS & ECKSTEIN, 187, 189, 191, & 193, Union Street, Borough, London, S.E.

Terra Cotta Door and Window Jambs.

Certificate of Merit, 1892.

To S. S. WAY, Portsmouth.

DIVISION C.—CLASS I.—Section 3. Paints and other Protectives.

Antioxide.

Certificate of Merit, 1889.

To PETERS, BARTSCH & Co.

DESCRIPTION.—For making into paint to be used for preventing Rust on Iron, Steel, and other Metals; as a paint for protecting Wood; and for preserving Placards exposed to the weather.

PRICES.—7s. 6d. per Tin of ½ Gallon.

Manufactured by PETERS, BARTCSH & Co., Derby.

Carbolineum Avenarius.

Certificate of Merit, 1889.

To PETERS BARTSCH & Co.

USE.—For preserving Wood and Ropes, and preventing dampness in Walls.

SIZE AND PRICE.—4s. 3d. per 1 Gallon Tin.

Imported by PETERS, BARTSCH & Co., Derby.

Aspinall's Enamel and Lacquers.

Certificate of Merit, 1890.

To ASPINALL, ASPINALL & Co.

DESCRIPTION.—Enamel made in various Colours for painting and protecting Ironwork, Woodwork, &c., and for Decorative purposes.

PRICES.—2d., 5d., 1s. 3d., and 2s. 6d. per Tin; and £1 per Gallon.

Manufactured by ASPINALL'S ENAMEL Co., Limited, New Cross, S.E.

DIVISION C.—Class I.—Section 4. Wall Paper and Coverings.

Excellence of Design and Colour in Wall Papers and Silk Hangings.

Medal, 1890.

To D'Oyly & Co.

DIVISION C.—Class I.—Section 5. Flooring.

Solid Wood-Block Floor Paving.

Certificate of Merit, 1889.

To Holloway Bros.

Description.—This Paving is laid in Blocks, each Block having two of its sides splayed or tapered one way, and the two other sides the reverse way, so that they may be interlocked without the aid of ties or fastenings.

Sizes of Blocks.—$1\frac{1}{2}$ in. to 4 in. in thickness, and from 12 in. to 18 in. square, superficial.

Price.—$1\frac{1}{2}$ in. thick, 6s. 6d. per yd. super.

Manufactured by Holloway Bros., Queen's Road, Battersea.

DIVISION C.—Class I.—Section 6. Decorative Materials.

Wood Moulding.

Certificate of Merit, 1890.

To Beves & Co.

Description.—Wood Mouldings wrought both in hard and soft woods.

Manufactured by Beves & Co., Church Street, Brighton.

DIVISION C.—CLASS I.—**Section 6.** *(Continued.)*

Exhibit of Art Porcelain.

Medal, 1889.

To THE WORCESTER ROYAL PORCELAIN CO.

Manufactured by THE WORCESTER ROYAL PORCELAIN CO.

Exhibit of Flooring and Wall Tiles.

Medal, 1889.

To WEBB'S WORCESTER TILERIES CO.

Manufactured by WEBB'S WORCESTER TILERIES CO., Worcester.

Enamelled Iron Plates for Decorative Purposes.

Certificate of Merit, 1889.

To HERMANN HEIM, 405 Oxford Street, W.

Decorative Tiles and Pottery.

Certificate of Merit, 1890.

To H. CRESSWELL.

Manufactured by VARIOUS FIRMS.

DIVISION C.—CLASS I.—Section 6. *(Continued.)*

Exhibit of Decorative Pottery and Faience.

Medal, 1890.

To BURMANTOFT'S WORKS.

Manufactured at BURMANTOFT'S WORKS, LEEDS FIRECLAY CO., LIMITED.

Good Design and Colour in Upholstery Silks.

Certificate of Merit, 1890.

To F. OLIVER & CO.

Artistic Pottery and Porcelain.

Certificate of Merit, 1890.

To J. HAINES, 70, Church Road, Brighton.

Fancy Wood Decorations.

Certificate of Merit, 1890.

To J. F. & G. HARRIS.

DESCRIPTION.—Adapted for Ceilings, Walls, Dados, &c. They can be fixed either straight or on a curve, being constructed for secret nailing.

SIZE.—Made from $\frac{1}{2}$ in. to any thickness and in various woods.

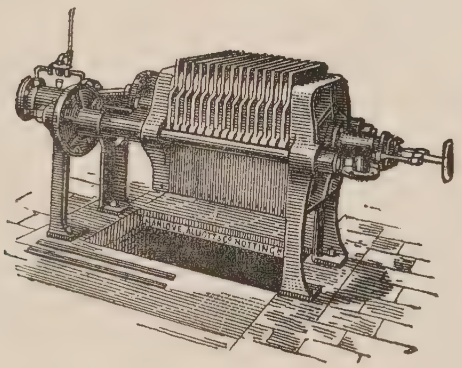
Made by J. F. & G. HARRIS, 58 & 60, Wilson Street, Finsbury, E.C.

DIVISION C.— Class I.—Section 7. Machinery and Mechanical Appliances.

Paton's Filter Press, with Pneumatic Attachment.

Medal, 1889.

To Manlove, Alliott & Co.



Description.—The Filter-Press is an apparatus designed to filter sewage sludge through cloth or other similar filtering medium, which is fixed on movable frames arranged in such a manner that a large amount of filtering surface is provided in a small compass. The cloth being firmly supported, the liquid may be forced through under considerable pressure. The Press is intended to deal with the sludge as it comes from the settling tanks, and to discharge it in the form of dry cakes.

Manufactured by Manlove, Alliott & Co., Limited, Engineers, Nottingham.

DIVISION C.—CLASS I.—**Section 7.** *(Continued.)*

Fryer's "Destructor" with Jones's "Cremator."

Medal, 1889.

To MANLOVE, ALLIOTT & CO.

DESCRIPTION.—The "Destructor" consists of a series of Furnaces or Cells with Sloping Hearth, so constructed that the refuse is fed on to the back or upper portion of the furnace, direct from the carts in which it is collected, without any sorting or handling.

The "Cremator" is a Supplementary Furnace, through which all the gases produced in the burning of the refuse are made to pass on their way to the chimney, and the gases being thus raised to a very high temperature, are rendered innocuous and inoffensive before being allowed to escape through the chimney into the atmosphere.

PRICE.—Varies from £400 to £1500 per Cell.

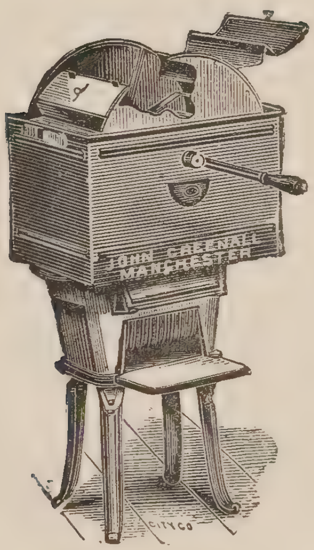
Manufactured by MANLOVE, ALLIOTT & CO., Limited, Engineers, Nottingham.

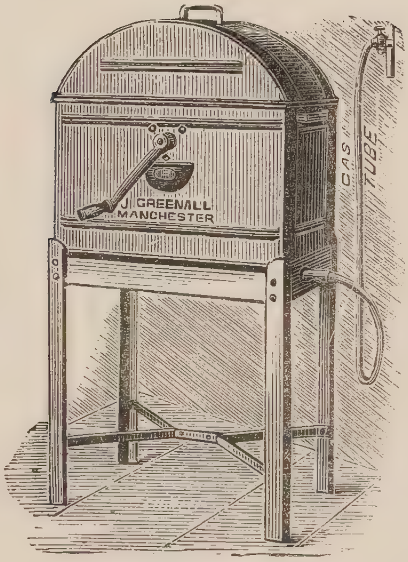
DIVISION C.—Class I.—**Section 8. Laundry Appliances.**

Greenall's Steam Washer.

Medals, 1890 and 1892.

To John Greenall





Description.—The Steam Washer is a combination of Boiler and Washing Machine, which boils and washes the clothes at one operation. The clothes, well soaked and soaped, are put into a cylinder which revolves in steam, generated from water in the bottom of the Washer, heated by gas or a coal or coke stove, and the cylinder is then turned slowly for ten minutes. The water by which the clothes are saturated is thus converted into steam, and the expansion (caused by this conversion of water into steam) loosens and carries off the particles of dirt.

Prices.—From £4 4s. to £12 12s. Domestic and Hand power.

Manufactured by John Greenall, 120, Portland Street, Manchester.

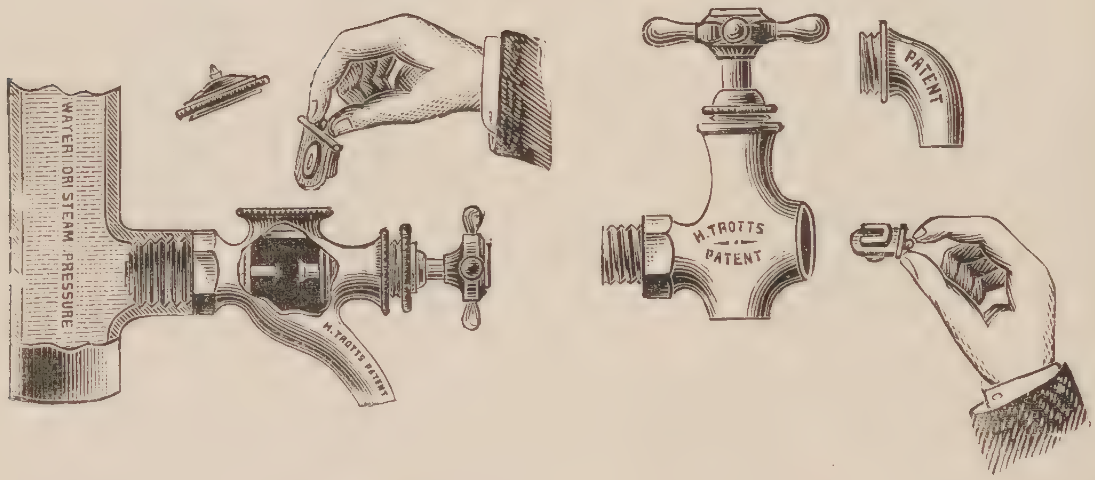
DIVISION C.—Class II.—WATER SUPPLY AND SEWERAGE.

DIVISION C.—Class II.—Section 1. Apparatus for Water Supply.

Removable Valves for Hot and Cold Water Cocks.

Certificates of Merit, 1889 and 1892.

To H. Trott.



Description.—These Valves consist of a Sliding or Swinging Valve in a chamber covered with a screwed Cap or Nozzle, the unscrewing of which facilitates the removal of the inner Valve, and the insertion of new Asbestos or Metal Discs, when necessary.

Sizes.—$\frac{3}{8}$ in., $\frac{1}{2}$ in., $\frac{3}{4}$ in., 1 in.

Prices.— 6/3 8/- 10/3 16/3

Manufactured by H. Trott, 75, 77, and 79, High Street, Battersea, S.W.

DIVISION C.—CLASS II.—**Section 1.** *(Continued.)*

Combined Bath Valve with Interlocking Gear for Waste.

Certificate of Merit, 1892.

To TROTT VALVE AND ENGINEERING CO.

DESCRIPTION.—The Apparatus is operated by one handle turning round a front indexed dial-plate, and supplies hot, cold, and tepid water in any required proportions to the Bath through the same outlet, and also controls the waste valve which, by a simple interlocking arrangement, cannot be opened unless the inlet valves are closed.

PRICES.—Without waste, £5; Including waste, &c., £5 10s. and £6.

Manufactured by THE TROTT PATENT VALVE AND ENGINEERING CO., LTD., Battersea, London, S.W.

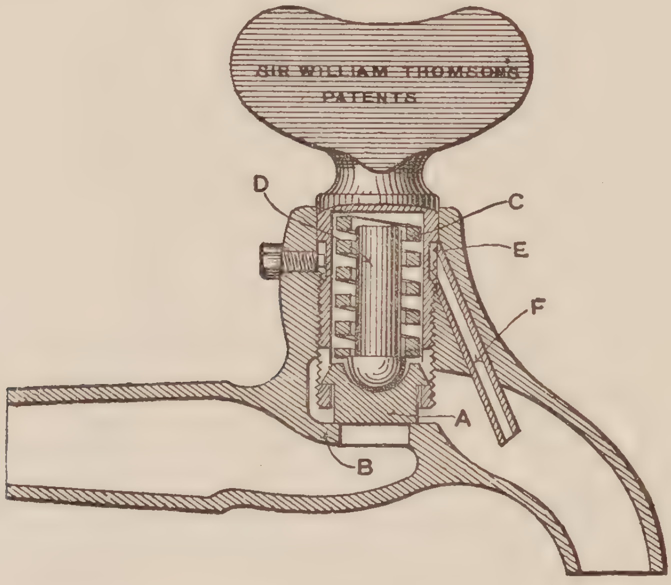
DIVISION C.—CLASS II.—**Section 1.** *(Continued.)*

Sir Wm. Thomson's Water Tap.

Certificates of Merit, 1890 and 1892.

To BOSTEL BROS. (1891).

To PORTSMOUTH WATER FITTINGS CO. (1892).



DESCRIPTION.—The metal valve A on reaching the seat B, also of metal, is not suddenly arrested, and compelled to seat itself haphazard, but continues to turn upon its seat as the handle is turned, receiving meanwhile a gradually increasing pressure from the spring C, centrally applied through the medium of the rounded head of the stop D. The valve is thus rubbed upon its seat at every opening and closing. No packing is used to prevent upward leakage. All water which passes the screw when the tap is open enters the annular space E, and is drawn off into the bib through the eduction tube F, in which a current is induced by the velocity of the water flowing through the bib.

SIZES.—	$\frac{3}{8}$,	$\frac{1}{2}$,	$\frac{5}{8}$,	$\frac{3}{4}$,	1,	$1\frac{1}{4}$,	$1\frac{1}{2}$,	2.
PRICES.—	3s.,	4s. 2d.,	5s. 3d.,	6s.,	8s. 9d.,	18s.,	26s.	44s.

Manufactured by PALATINE ENGINEERING CO., 10, Blackstock Street, Liverpool.

DIVISION C.—Class II.—Section 1. *(Continued)*

Self-Acting Air Valves.

Certificate of Merit, 1889.

To Guest & Chrimes.

Manufactured by Guest & Chrimes, Rotherham.

Improved Chain Pump.

Certificate of Merit, 1890.

To W. Clemens Abell & Co.

Description.—Consists of an Endless Chain with Discs of iron fixed at the joints, which is drawn through the barrel of the Pump.

Sizes.—2 in. to 4 in.

Prices.—Pump 12 ft., £4 to £8; for extra length 5s. to 10s. 6d. per Foot.

Manufactured by W. Clemens Abell & Co., Worcester Wagon Works, Worcester.

Baker's Water Hydrant.

Certificate of Merit, 1890.

To Brighton Water Works Company.

DIVISION C.—CLASS II.—**Section 1.** *(Continued.)*

Armoured India Rubber Hose.

Certificate of Merit, 1890.

To MERRYWEATHER & SONS.

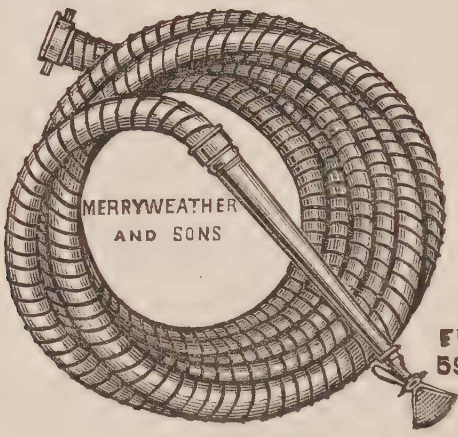


FIG 595.

DESCRIPTION.—A Hose of India Rubber with Canvas Plies bound on the outside with Wire of Spring-Steel or Brass, the coil being self-holding and preventing wear of the Rubber by abrasion, and enabling the Hose to stand great internal pressure.

SIZES.—Made in all sizes from ½ in. upwards.

PRICE.—2s. per foot, 1 in. internal diameter.

Manufactured by MERRYWEATHER & SONS, LIMITED, Greenwich Road, S.E., and 63, Long Acre, W.C., London.

Enamelled Fireclay Cisterns.

Medal, 1892.

To BROAD & Co.

DESCRIPTION.—The Cisterns are enamelled and glazed on the inside surfaces of sides, and bottom, all sharp angles being avoided.

SIZES.—	36 × 24 × 18 ;	42 × 24 × 20 ;	42 × 24 × 24.
PRICES.—	£3 10s.	£4 5s.	£5

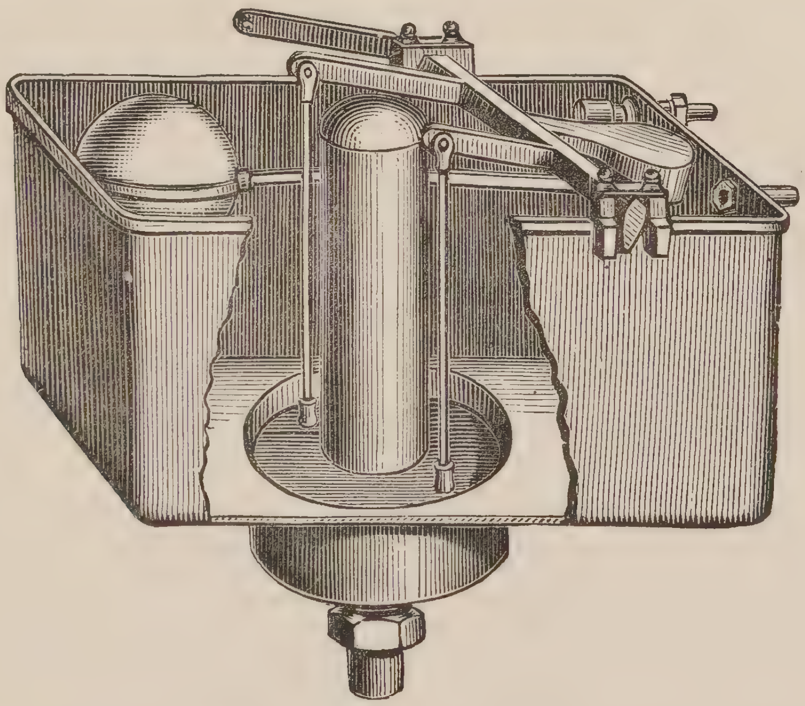
Manufactured by BROAD & Co., South Wharf, Paddington.

DIVISION C.—Class II.—Section 3. Water Waste Preventers.

Shanks's "Reliable" Water-Waste Preventer.

Certificates of Merit, 1889 and 1892.

To J. Ward & Son, 1889.
To Portsmouth Water Fittings Co., 1892.



Description.—Is made entirely without valves, on the Siphon principle. There is a Well or Dip, in which an Annular Disc works but does not fit closely, and through the centre of this Disc stands the Siphon-Pipe. The Disc being depressed by the Lever, forces the water into the Pipe and starts the Siphon.

	Painted,	Glass Enamelled,	Galvanized,	Porcelain Enamld.
Prices.—2 Galls.,	19/6	24 -	24/6	26/6
3 „	21/6	26/-	27/-	29/-
4 „	25/-	30/-	32/-	33/-

Manufactured by Shanks & Co., Barrhead, N.B.

"Tornado" Water-Waste Preventer.

Certificate of Merit, 1889.

To R. W. Tomlinson, Worcester.

The Winser After-Flush Cistern.

Certificate of Merit, 1889.

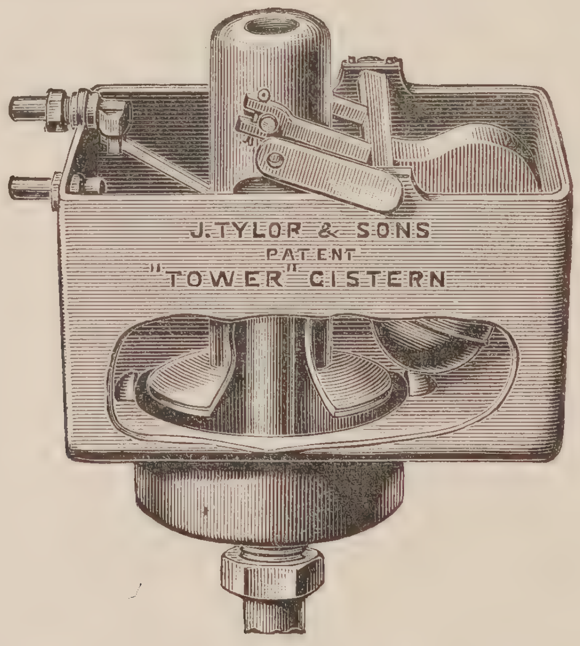
To Winser & Co.

Manufactured by Winser & Co., 52, Buckingham Palace Road, S.W.

"Tower" Waste Preventer.

Medal, 1890.

To J. Tylor & Sons, Limited.



Description.—This is an Annular Siphon Cistern; by pressing the iron dome into the well in which it works, the water is driven into the pipe and starts the Siphon.

Sizes.—1 Gallon (for Urinals), 2 Gallons, and 3 Gallons.

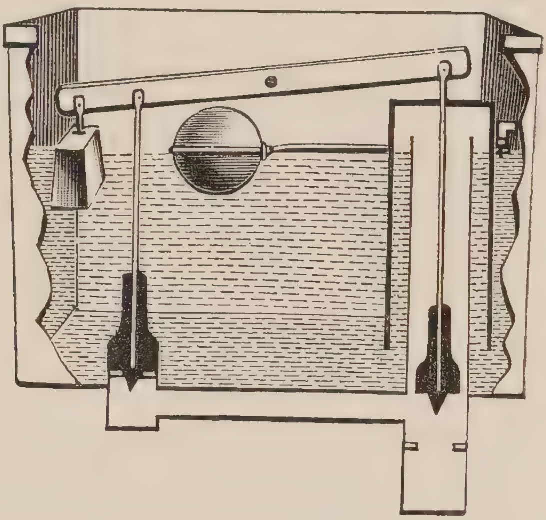
Prices.—1 Gallon from 18s.; 2 Gallons from 19s.; 3 Gallons from £1 4s.

Manufactured by J. Tylor & Sons, Limited, 2, Newgate Street, E.C.

The Presto Seat Action Siphon Waste Preventing Cistern.

Certificate of Merit, 1892.

To John Knowles & Co.



Description.—The apparatus (which is adaptable to any kind of wash-down or washout closet) consists of four parts, viz., a Seat, a Rocking Board pivotted in two side brackets, the latter having each a vertical slot and a round hole in it. The Seat is pivotted loosely in these slots, and midway on each side of the seat underneath is an indiarubber "boss," which rests on the rim of the closet pan and serves as a fulcrum on which the seat will rock. The front of the Seat being pressed down, the back part is raised, and here the Rocking Board is brought into action. This Rocking Board extends across the whole length of the back part of the seat, and is pivotted in the holes of the side brackets. It has at each end (right and left) a projecting arm which overlies and rests upon the cam piece attached to the seat pin. When the Seat is pressed upon in front these arms are lifted and the back part of the Rocking Board depressed. The chain, which moves the cistern lever being attached to the back part of the Rocking Board, is thereby pulled. The Seat has however a *double action*, for on being *lifted up* (for the purpose of using the closet as a urinal or for emptying slops, &c.) the metal cam pieces attached to the seat pins force up the projecting arms of the Rocking Board, and a pull on the chain is again secured. When the Seat is returned to its normally horizontal position a discharge of water again takes place. The cistern discharges are effected by a siphon set in action in the following manner:—Two valves attached to a lever are used, one valve (called the siphon valve) being inside the discharge arm of the siphon, the other valve (called the cistern valve) being in the cistern at the other end of the lever. The chain pull opens the cistern valve and closes the siphon valve, and the water runs through a duct at the bottom of the cistern into the siphon. When the chain is released the weight closes the cistern valve, raises the siphon valve, and the water contained in the duct starts the siphon, and the contents of the cistern are discharged.

Price.—£3 10s.

Manufactured by John Knowles & Co., 38, King's Road, St. Pancras, N.W.

DIVISION C.—CLASS II.—**Section 3.** *(Continued.)*

Silent Arrangement for Tower Waste Preventer.

Certificate of Merit, 1892.

To J. TYLOR & SONS, LIMITED.

DESCRIPTION.—A Valve, with weight and float, is attached to dome of Siphon. When the dome is pulled down to start the Siphon, the weight keeps the Valve closed; but when the water level falls in the Cistern, below the float, the Valve is opened, admitting air into the *top* of the Siphon, and preventing the gurgling noise formerly made when air and water entered together at the bottom of the Siphon.

PRICE.—6s. 6d. in addition to price of Cistern.

Manufactured by J. TYLOR & SONS, LTD., 2, Newgate Street, London, E.C.; and Belle Isle, York Road, N.

Quick Filling Siphon Flush Cistern for Closets.

Certificate of Merit, 1892.

To G. JENNINGS.

Manufactured by G. JENNINGS, Stangate, Lambeth.

DIVISION C.—CLASS II.—**Section 4. Flushing and Watering.**

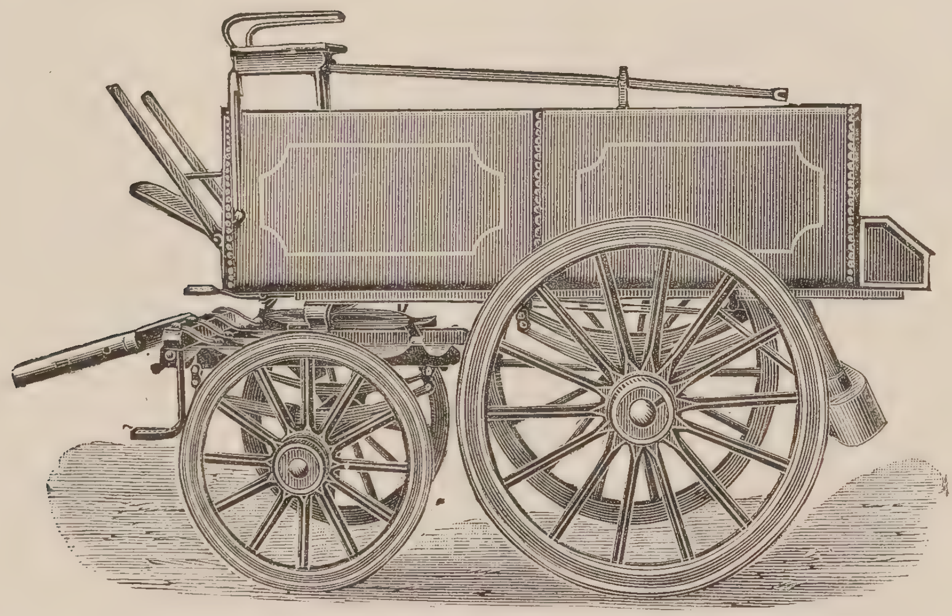
Improved Street Watering Van with Double Distributors and Valves.

Certificates of Merit, 1889 and 1890.

Balanced Water Cart.

Certificate of Merit, 1892.

TO W. CLEMENS ABELL & CO.



DESCRIPTION.—Constructed with bodies of flanged steel plates, riveted to the iron frame of channel, and Tee Bars, fitted with Double Distributors and Valves for watering the whole or any section of the road. Either of the Valves can be instantly stopped by the driver.

SIZES.—300 Gallons, 350 Gallons, 400 Gallons, and 460 Gallons.

PRICES.— £40, £41 10s., £43, £45.

Manufactured by W. CLEMENS ABELL & CO., Worcester Wagon Works, Worcester.

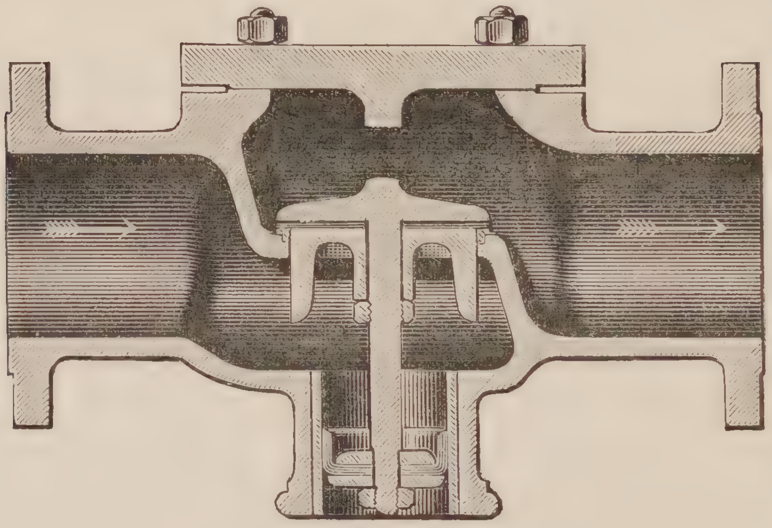
DIVISION C.—CLASS II.—**Section 4.** *(Continued.)*

Excellence in Manufacture of Water Fittings.

Medal, 1889.

TO GUEST & CHRIMES.

Pressure-Reducing Valve.



DESCRIPTION.—By varying the size of the Piston underneath the Valve at the inlet side, the pressure in water mains beyond the Valve or in house service pipes be may reduced to any extent desired. Made with Cast Iron body and Gun Metal working parts.

PRICES.—From £2 2s. to £7 each.

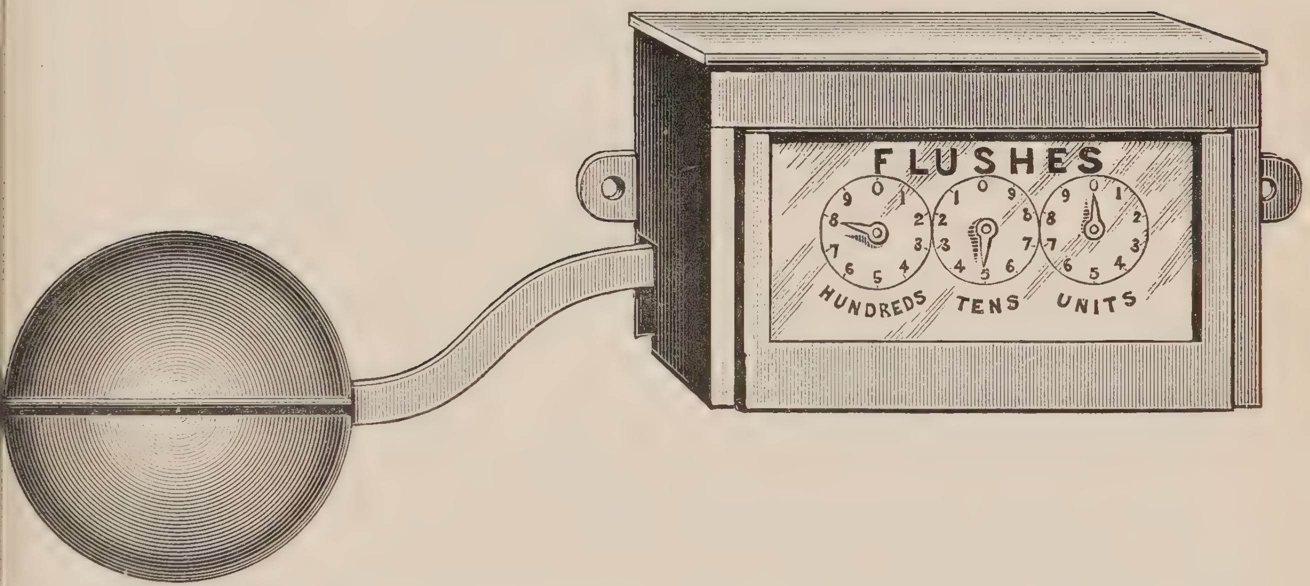
Manufactured by GUEST & CHRIMES, Rotherham.

DIVISION C.—CLASS II.—**Section 4.** *(Continued.)*

Flush Indicator.

Certificate of Merit, 1892.

To WATER CARRIAGE ENGINEERING CO.



DESCRIPTION.—This instrument is constructed so as to record, by the action of a floating ball, exactly the number of flushes given from a flush Tank. It enables a meter to be dispensed with, as the number of flushes recorded, multiplied by the capacity of the cistern in gallons, give the consumption of water.

SIZE.—(Illustration) Half Full Size.

PRICE.—No. 7, 12s. 6d.

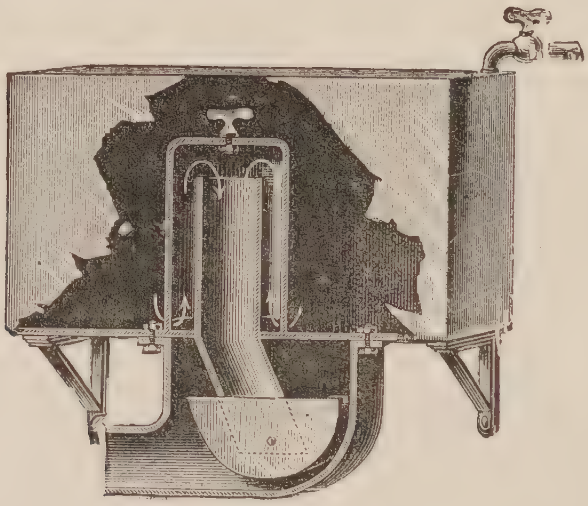
Manufactured by THE WATER CARRIAGE ENGINEERING CO., LIMITED, Sheffield.

DIVISION C.—CLASS II.—Section 4. *(Continued.)*

Automatic Flushing Siphon with Tipping Bucket at Outlet.

Certificate of Merit, 1892.

TO WATER CARRIAGE ENGINEERING CO.



DESCRIPTION.—When the feed water has risen in the tank as high as the bend of the siphon, it runs down the long leg into the tipping bucket, which is placed in the chamber underneath. When it has risen in this tipping bucket to the bottom of the long leg it traps the siphon. In the act of trapping it slightly compresses the air in the pipe, and as a consequence the feed ceases to run down the long leg until the water in the tank has risen sufficiently high to form a head with a pressure sufficient to overcome the air pressure in the siphon. This slight head, forces more water down into the tipping bucket, which compresses the air in the siphon still more, and consequently requires a greater head to force more water down. When the tank is filled to the required level the tipping bucket is also filled to its tipping point, and it then cants over and discharges its contents, untrapping the siphon and releasing the compressed air contained in it, the head of water in the tank instantly charging the siphon.

SIZES.—15 Gallons to 200 Gallons.

PRICES.—From £2 10s. to £13.

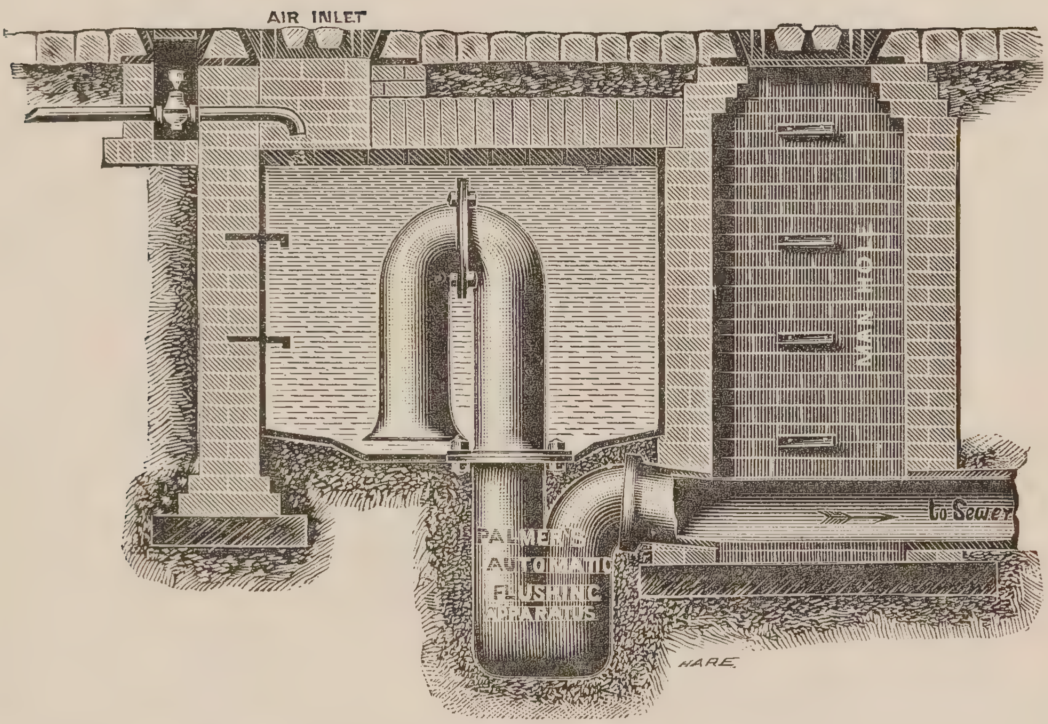
Manufactured by THE WATER CARRIAGE ENGINEERING CO., LIMITED, Sheffield.

DIVISION C.—Class II.—Section 4. *(Continued.)*

Palmer's Automatic Flushing Siphon.

Certificate of Merit, 1892.

To E. R. Palmer.



Sizes.—2 ft. to 36 ft. diameter.

Prices.—From £2 upwards according to size.

In Parts.—Three parts.

Manufactured by E. R. Palmer, Hygiene Works, Beckenham.

The Climax Automatic Flushing Siphon.

Certificate of Merit, 1892.

To S. Grossmith, Daniel Street, Portsea.

DIVISION C.—CLASS II.—**Section 5. Sinks.**

Yorkshire Salt-Glazed Sink.

Certificate of Merit, 1889.

To JOSEPH CLIFF & SONS.

DESCRIPTION.—Made in Salt-Glazed Stoneware in various shapes and sizes.

SIZE.—24 in. × 18 in.; 6 in. outside.

PRICE.—6s.

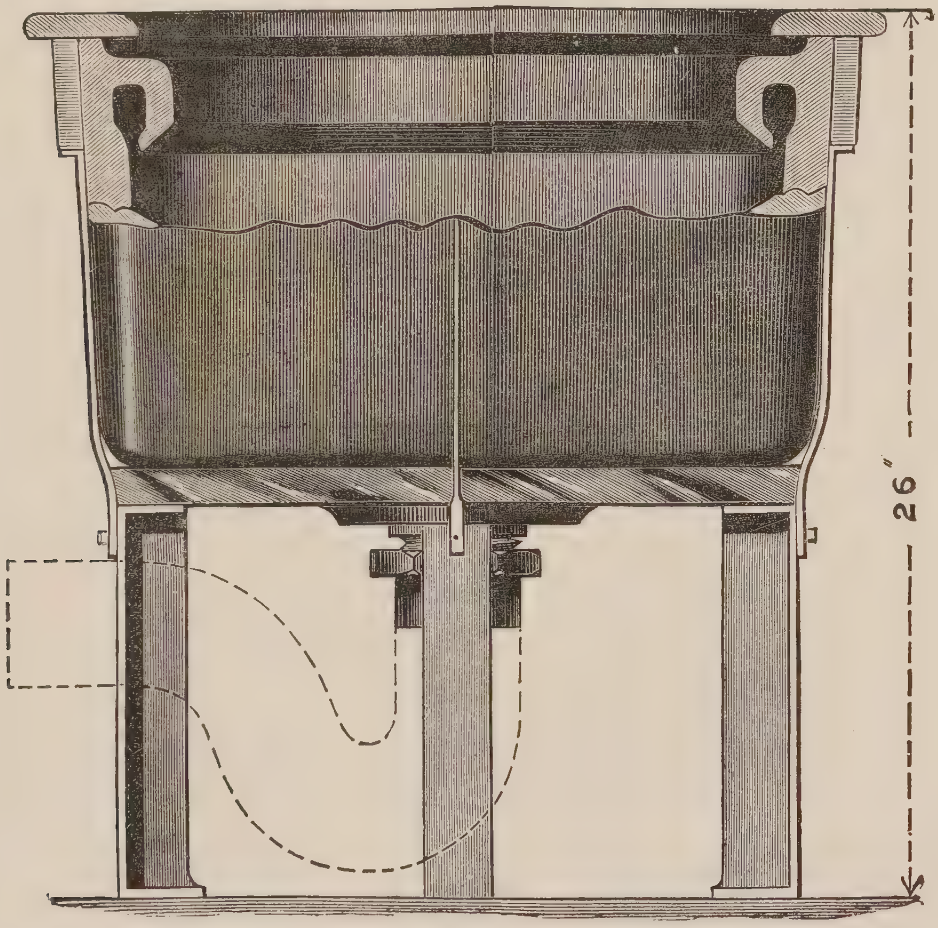
Manufactured by JOSEPH CLIFF & SONS, Wortley, Leeds.

DIVISION C.—CLASS II.—**Section 5.** *(Continued.)*

"Cecil" Slop Sink.

Medals, 1889 and 1890.

To JOSEPH CLIFF & SONS.



DESCRIPTION.—The chief feature in this Sink is the flushing rim which is made in the material and is part of the Sink itself. The Sink is fixed with a lead trap above the level of the floor.

	No. 2.		No. 1.	
SIZES.—	18 in. × 18 in.	and	22 in. × 22 in.	outside.

PRICES.—£1 17s. 6d. and £3 10s.

IN PARTS.—Galvanized Iron Frame and Legs, including Iron Straps and Tie Rods, 15s.; Pitch-pine Top, 15s.; Brass Outlet and Union, 11s. extra per set.

Manufactured by JOSEPH CLIFF & SONS, Wortley, Leeds.

DIVISION C.—CLASS II.—Section 5. *(Continued.)*

Enamelled Fire Clay Hospital Sink.

Certificate of Merit, 1889.

White Enamelled Fire Clay Sink.

Certificate of Merit, 1890.

TO JOSEPH CLIFF & SONS.

DESCRIPTION.—Made in "Imperial" Ware.

SIZES.—20 in. × 16 in.; 13 in. outside.

PRICE.—£1 5s.

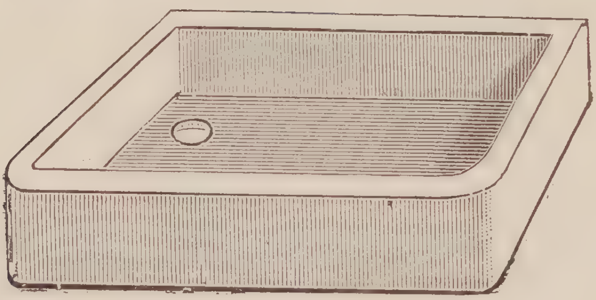
Kitchen, Housemaid, Butler's, and other forms are made in same ware.

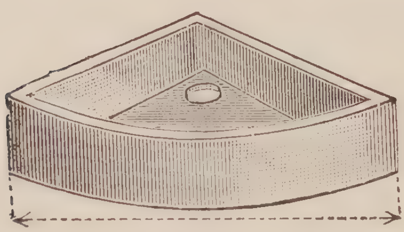
Manufactured by JOSEPH CLIFF & SONS, Wortley, Leeds.

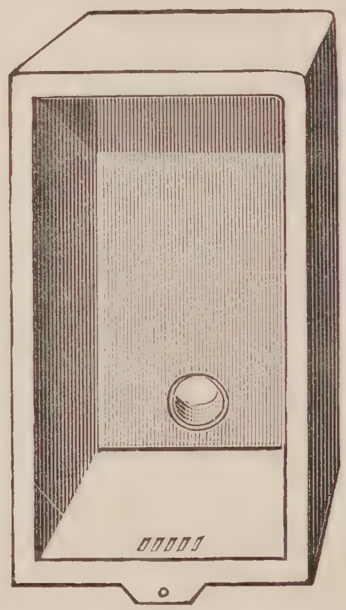
White Enamelled Fireclay Sinks.

Certificate of Merit, 1892.

TO BROAD & CO.







SIZES AND PRICES.—20 × 15 × 6½ in. to 48 × 24 × 8 in. outside, 10s. to £2 10s.; 21 × 15 × 8½ in. to 48 × 24 × 12 in. outside, 14s. to £3. White enamel, 2 ft., 12s., 2 ft. 4 in., 15s. Cane glazed, 2 ft., 6s., 2 ft. 4 in., 7s. 6d.

Manufactured by BROAD & CO., South Wharf, Paddington.

DIVISION C.—CLASS II.—**Section 5.** *(Continued.)*

Indurated Wood Fibre Sinks.

Certificate of Merit, 1892.

TO MILNE, SONS & MACFIE.

DESCRIPTION.—Moulded in one piece and made without joint or seam. The pores of the Fibre are filled with a hardened or indurating material and subjected to a high degree of heat. The inner surface is lined with eburite enamel. The material for Sinks is made about half-inch thick and is very light; made also in Closet Seats, Wash Tubs, and Baths.

SIZE.—Outside 19 × 26 × 7 inches deep.

PRICE.—£2.

Manufactured by MILNE, SONS & MACFIE, 60, Holborn Viaduct, E.C.; and JAMES MILNE & SON, Milton House Works, Edinburgh.

DIVISION C—CLASS II.—Section 6. Baths and Lavatories.

Rufford's Porcelain Bath.

Medals, 1889.

To R. W. TOMLINSON, Worcester.
To. J. WARD & SON, Worcester.

DESCRIPTION.—Moulded in one piece of Porcelain, and glazed inside and out.

SIZE.—68 in. long outside.

PRICES.—From £6 10s. to £10.

Manufactured by RUFFORD & Co., Stourbridge.

Imperial Spray Bath.

Certificate of Merit, 1890.

To J. SMEATON, SON & Co.

DESCRIPTION.—This Bath has Circular End and Spray Hood, which is so arranged that all the water from the various Needles and Spray Jets concentrates itself towards the centre.

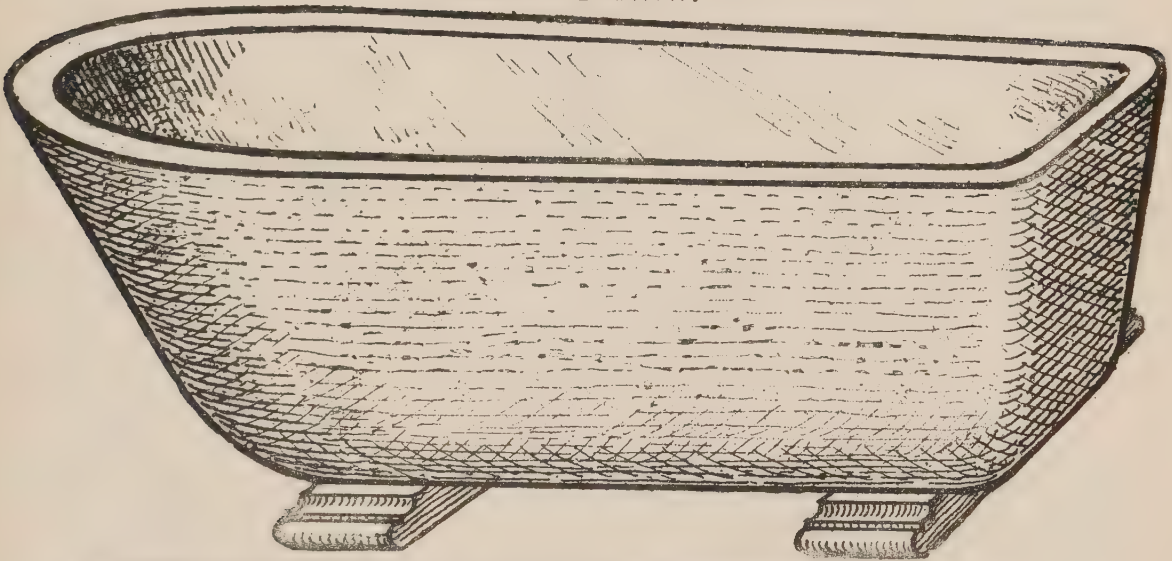
PRICES.—With all the Valves and arrangements for Shower, Spray, Douche, Wave, Sitz, Rose, and Plunge, with extra quick waste valve, and brass rod pipe, waste and overflow, in extra strong zinc, £22 10s.; ditto, with Copper Bath and Hood, £35 10s.

DIVISION C.—CLASS II.—**Section 6.** *(Continued.)*

Imperial Porcelain Bath.
Medals, 1889 and 1890.
Roman Bath.
Medal, 1889.
The Nursery Bath.
Medal, 1889.

To J. CLIFF & SONS.

IMPERIAL BATH.



DESCRIPTION.—These Baths are made of Imperial Porcelain Ware, with flat unglazed edge, for enclosing in wood casing, or with glazed roll edge and outside left plain for decorating without any enclosing woodwork.

SIZES.—Taper or Parallel Bath, 5 ft., 5 ft. 7 in., and 6 ft. long.
PRICES.—£7, £7 10s., £8, and £9 10s.; glazed roll, £1 10s. extra.

SIZE.—Roman Bath, 5 ft. 3 in. long.
PRICES.—£8; with glazed roll, £1 10s. extra.

SIZE.—Nursery Bath, 4 ft. 6 in. long.
PRICES.—£6; glazed roll, £1 10s. extra.

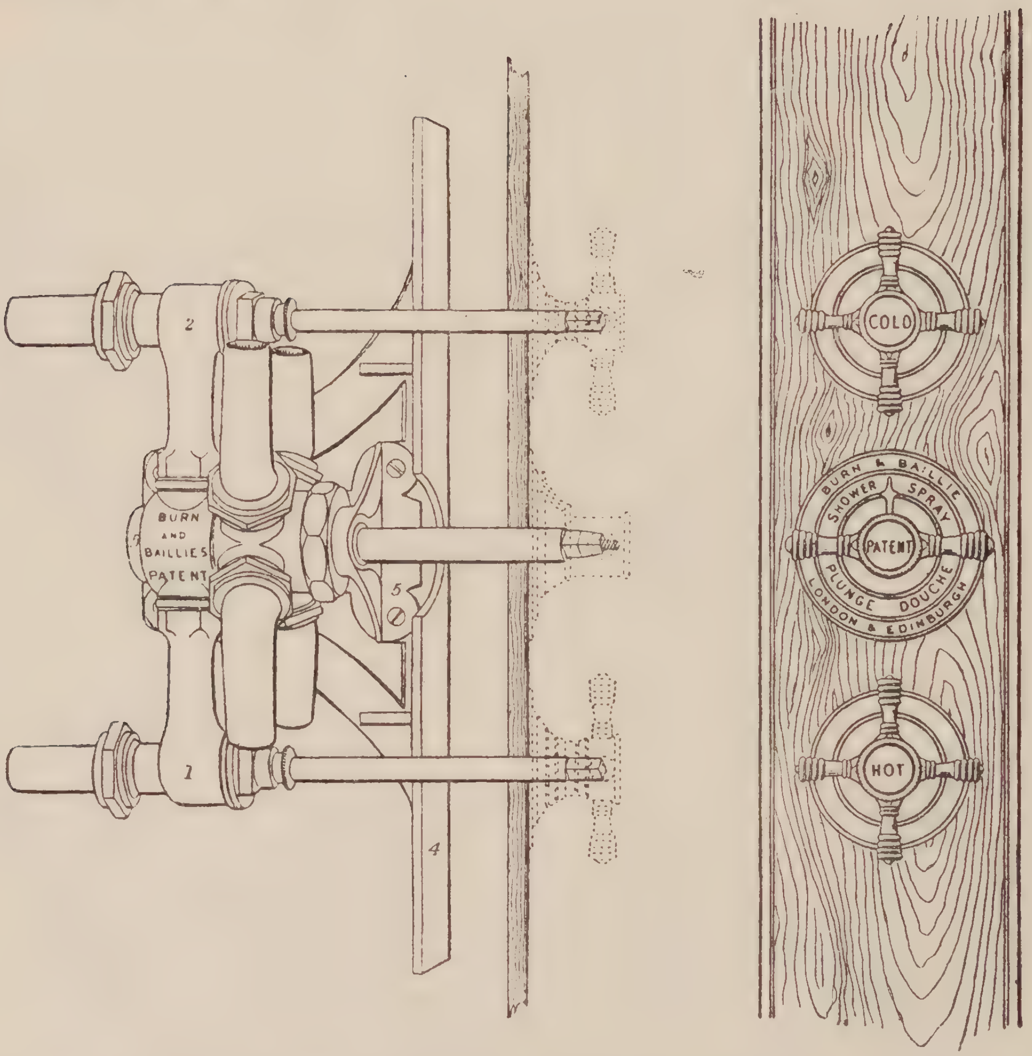
Manufactured by J. CLIFF & SONS, Wortley, Leeds.

DIVISION C.—CLASS II.—**Section 6.** *(Continued.)*

Combination Bath.

Certificate of Merit, 1890.

TO BURN & BAILLIE.



DESCRIPTION.—Only one handle is required in addition to the ordinary hot and cold water taps. When the temperature of the water has been regulated, by means of this handle, plunge, spray, shower, wave or douche may be obtained by simply turning the indicator to either on the dial plate.

Enamelled iron canopy, combination supply apparatus with four outlets for plunge, shower, spray, and wave or douche, with unions for hot and cold services.

SIZE.—5 ft. 9 in. long, inside.

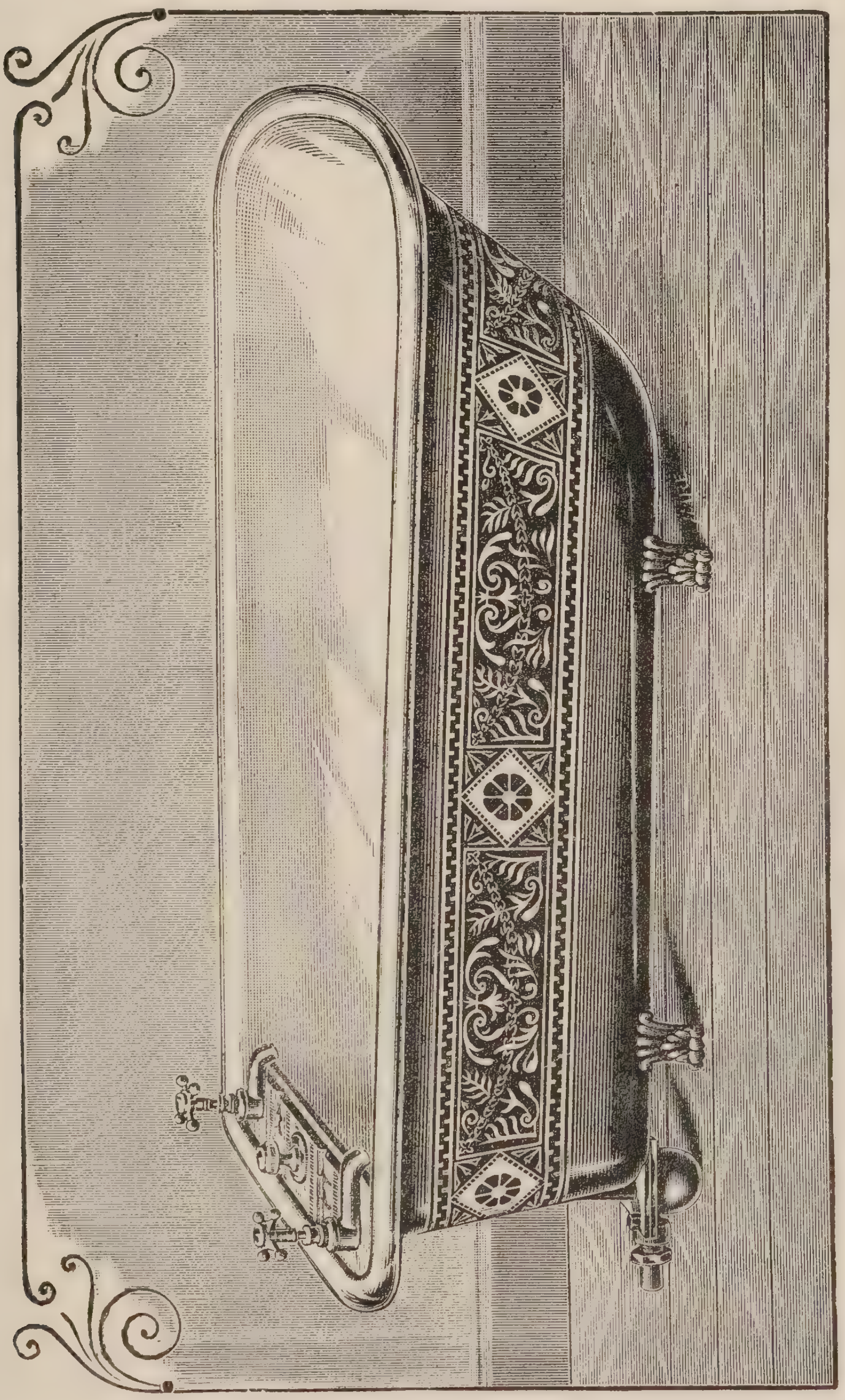
PRICE.—£16 15s.

Manufactured by BURN & BAILLIE, 14, Newcastle Street, Farringdon Street, E.C.

Shanks' Enamelled Iron Bath.

Certificate of Merit, 1892.

To PORTSMOUTH WATER FITTINGS CO.



DESCRIPTION.—Fitted with hot, cold, and waste fittings, soap dishes, standing waste and overflow in one piece with the Bath. Adjustable trap. With rolled edge, ornamental feet, and outside decorations. To stand without wood enclosure.

SIZE.—5 ft. 6 in.

PRICE.—Japanned, £3 9s. 6d. and £4; metallic enamelled, 2nd quality, £4 15s. 6d. and £5 8s.; metallic enamelled, 1st quality, £5 12s. 6d. and £6 5s. 0d.; porcelain enamelled, £7 4s. and £7 17s. 6d. respectively. Taper and parallel sided, nickel-plated fittings, 3s. extra; trap above floor line, 1s. 6d. extra.

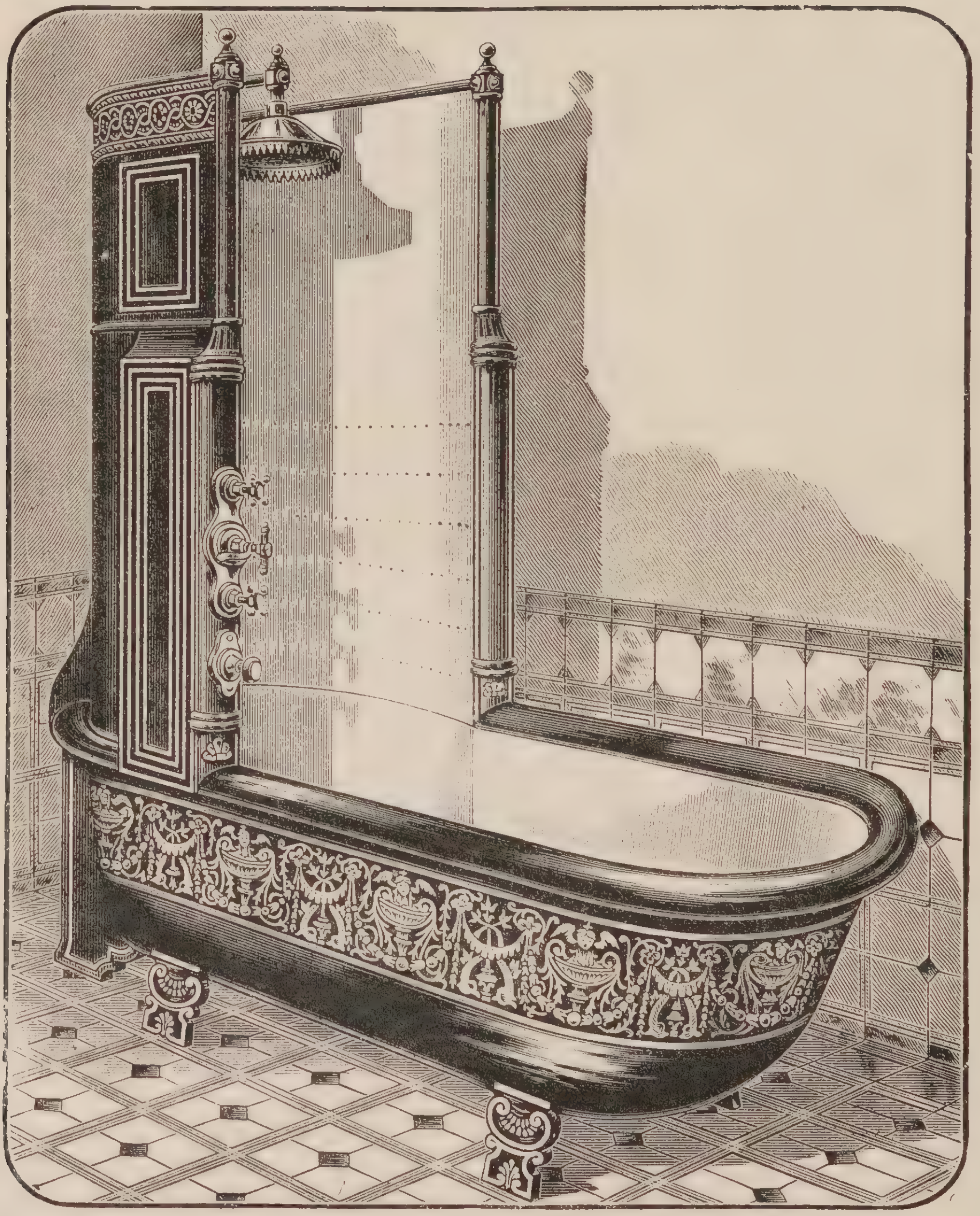
Manufactured by SHANKS & Co., Barrhead, N.B.

DIVISION C.—CLASS II.—**Section 6.** *(Continued.)*

Shanks' Independent Spray and Plunge Bath.

Certificate of Merit, 1892.

To PORTSMOUTH WATER FITTINGS CO.



DESCRIPTION.—Plunge is of cast-iron, with waste and overflow. Spray of zinc or copper. Fittings are the Eureka Fittings. Plunge, Spray, and Shower, with rolled edge and ornamented outside, to stand without enclosure. Fitted with Circular Spray.

PRICE.—Independent Bath, with Cast-Iron Plunge and Plate Zinc Spray, Metallic Enamelled inside and Japanned outside, with Nickel-Plated Shower and Tube, and Eureka Fittings, £27 10s.; with Copper Spray, £35.

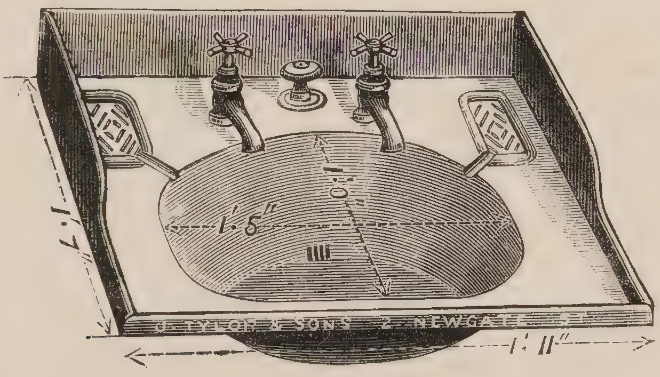
Manufactured by SHANKS & CO., Barrhead, N.B.

DIVISION C.—CLASS II.—Section 6. *(Continued.)*

Lavatory Basin and Fittings.

Certificate of Merit, 1890.

To J. TYLOR & SONS, LIMITED.



DESCRIPTION.—The Supply and Waste-Valves are fixed to it; by unscrewing the Cap of the Waste Pull-up the Overflow and Waste-Valves can be lifted out for cleaning. There is no metal in the Basin.

SIZES.—Basin, 14 in. × 11 in.; 17 in. × 12 in.; 18½ in. × 13 in.; 20 ins. × 14 in.; 28 in. × 21 in.

PRICES.—With Valves, £2 12s., £3, £3 10s., and £4, with Skirting, and £2 4s., £2 12s., £2 15s., and £3 3s. without Skirting. Plated Fittings, 5s. extra.

Manufactured by J. TYLOR & SONS, LIMITED, 2, Newgate Street, E.C.

Lavatories.

Certificate of Merit, 1890.

To BOSTEL BROS.

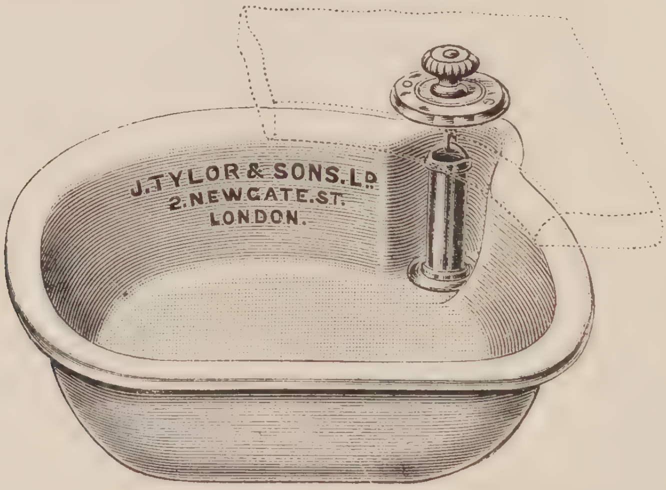
Manufactured by BOSTEL BROS., 18, Duke Street, Brighton.

DIVISION C.—CLASS II.—**Section 6.** *(Continued.)*

Lavatory with Lifting Standing Waste Outlet.

Certificate of Merit, 1892.

To J. TYLOR & SONS, LIMITED.



DESCRIPTION.—The Waste and Overflow Valve is placed in a recess in the basin, which allows of the valves being cleaned, and leaves the whole area of the basin available for use.

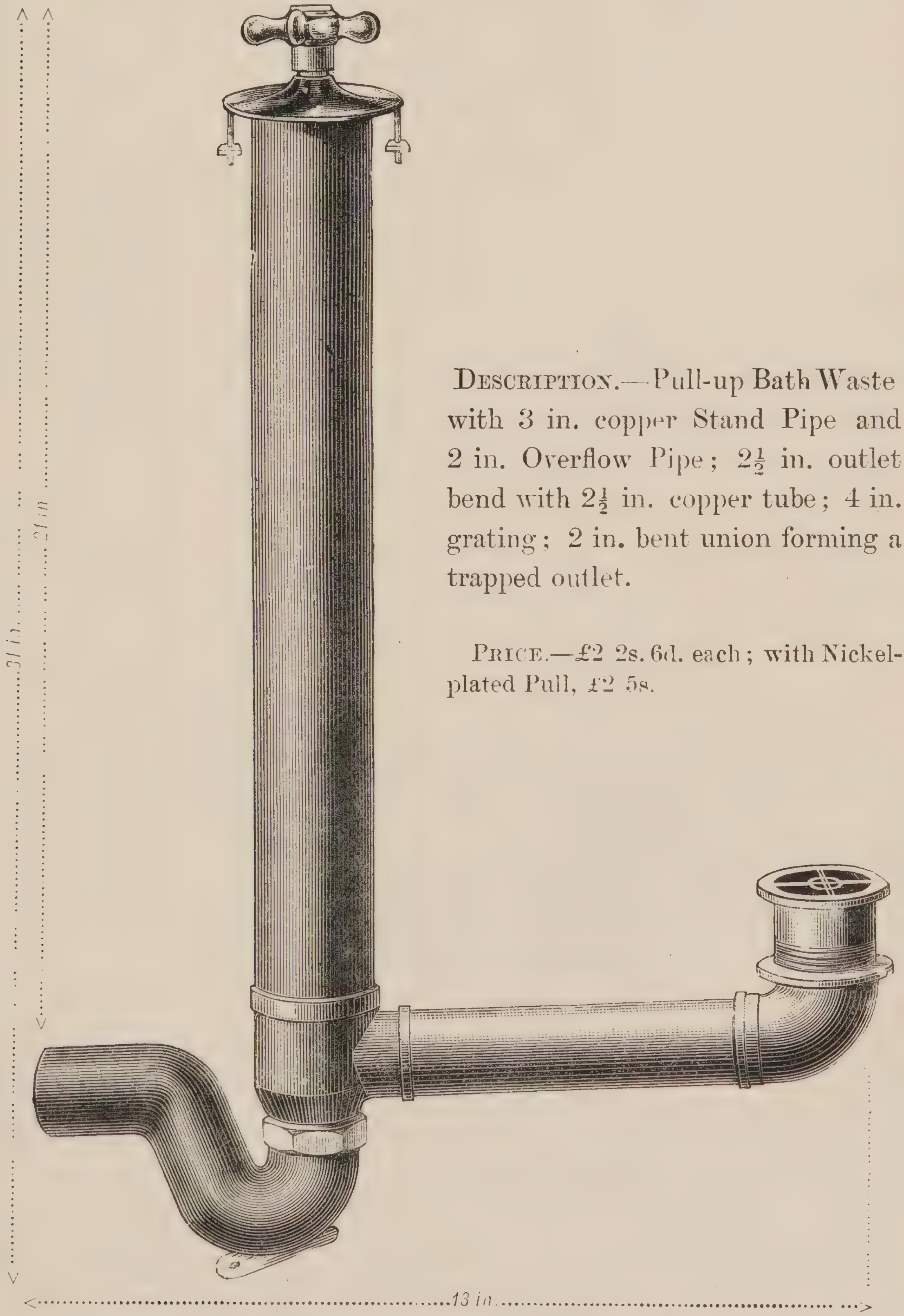
SIZES.—Four Sizes varying from 14 in. × 11 in. to 20 in. × 14 in.

PRICES.—From £1 10s. 6d. to £2 15s. 6d. Plated Mountings, 4s. 6d. extra.

Manufactured by J. TYLOR & SONS, LIMITED, 2, Newgate Street, E.C.; and Belle Isle, York Road, N.

Standing Waste and Overflow, with Trapping Bend for Bath.
Certificate of Merit, 1892.

To MILNE, SONS & MACFIE.



DESCRIPTION.—Pull-up Bath Waste with 3 in. copper Stand Pipe and 2 in. Overflow Pipe; $2\frac{1}{2}$ in. outlet bend with $2\frac{1}{2}$ in. copper tube; 4 in. grating; 2 in. bent union forming a trapped outlet.

PRICE.—£2 2s. 6d. each; with Nickel-plated Pull, £2 5s.

Manufactured by MILNE, SONS & MACFIE, 60, Holborn Viaduct, E.C.; and JAMES MILNE & SON, LIMITED, Milton House Works, Edinburgh.

DIVISION C.—CLASS II.—**Section 6.** *(Continued.)*

Hinged Grating for Overflow of Bath.

Certificate of Merit, 1890.

To BURN & BAILLIE.

DESCRIPTION.—The grating of overflow is hinged so as to permit of the overflow pipe being thoroughly cleansed by means of a brush.

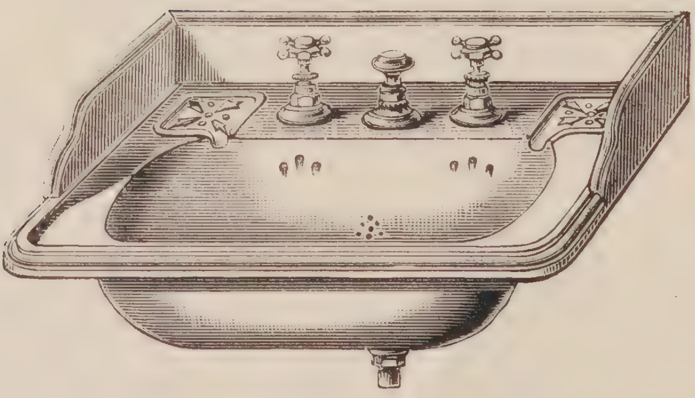
PRICES.—For Iron Bath, 10s. 6d.; For Fireclay Bath, 12s. 6d.

Manufactured by BURN & BAILLIE, 14, Newcastle Street, Farringdon Street, E.C.; and BURN BROTHERS, 23 & 24, Charing Cross, S.W.

Imperial Lavatory.

Certificate of Merit, 1889.

To J. WARD & SON.



DESCRIPTION.—It has a vertical stand-pipe, with waste and overflow made in one piece with the basin and table-top, and containing tubular plug, which acts as waste valve and overflow. The channels for the inlet of water are formed in the earthenware.

PRICE.—No. 90A Basin, $24\frac{1}{2} \times 18\frac{1}{4}$ in., with Bowl, 18×12 in., £3 8s.
,, 91A ,, $27\frac{1}{2} \times 20$,, ,, $20\frac{1}{4} \times 13\frac{1}{2}$,, £3 15s.

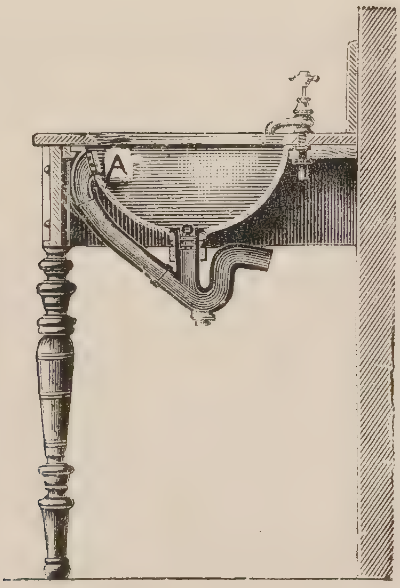
Manufactured by SHANKS & Co., Barrhead, N.B.

DIVISION C.—CLASS II.—**Section 6.** *(Continued.)*

Lavatory with Overflow which can be cleansed.

Certificate of Merit, 1890.

To BURN & BAILLIE.



DESCRIPTION.—The movable grating **A** affords easy access to the overflow pipe, which may be cleaned out down to the brass trap, which is arranged with the overflow pipe entering directly opposite the outlet, so that a free passage, without check, is provided for overflow water. The waste grating is made to lift out, and there is a brass cleansing screw in the bottom of the trap beyond.

SIZE AND PRICE.—Lavatory Basin, 14 ins. diameter inside, complete, and ready for fixing, from £3 7s. 6d. each.

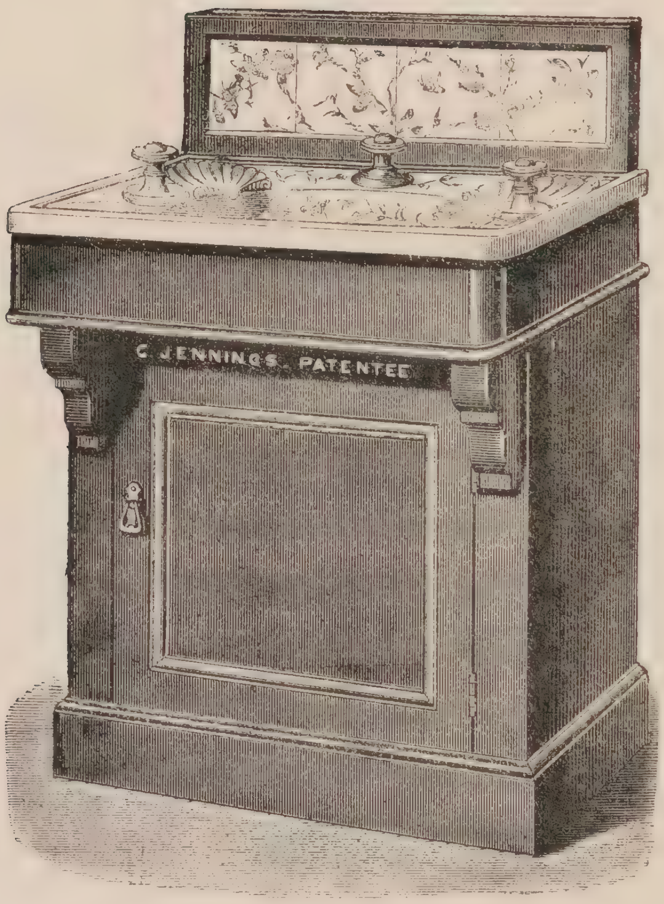
Manufactured by BURN & BAILLIE, 14, Newcastle Street, Farringdon Street, E.C.; and BURN BROTHERS, 23 & 24, Charing Cross, S.W.

DIVISION C.—CLASS II.—Section 6. *(Continued.)*

Cabinet Lavatory Stand.

Certificate of Merit, 1892.

TO G. JENNINGS.



DESCRIPTION.—The basin is square at back, rounded in front. Direct delivery of the supply over the edge of basin without projection, concealed overflow, earthenware outlet arm, removable discharge plug, and grating.

PRICES.—Rectangular, from £3 7s. 6d.; Angular, from £3 5s.

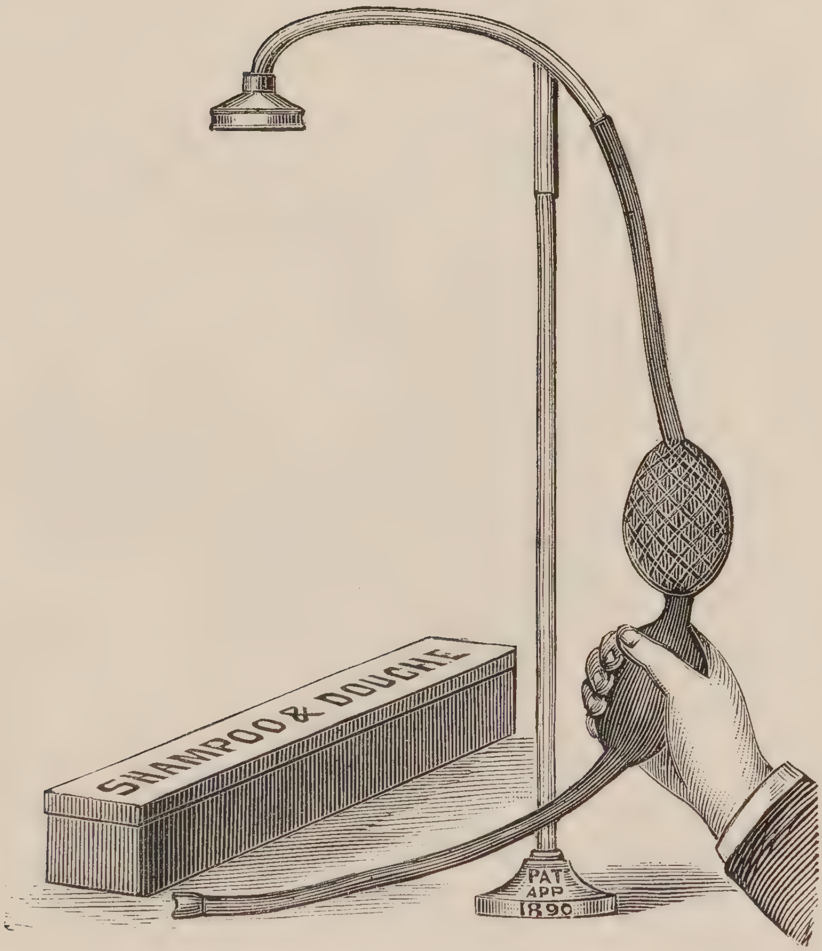
Manufactured by G. JENNINGS, Stangate, London, S.E.

DIVISION C.—CLASS II.—Section 6. *(Continued.)*

Shampoo and Douche.

Certificate of Merit, 1890.

To R. HOLBROOK.



DESCRIPTION.—Consists of a Stand and Spreader, with India Rubber Pumping Arrangement.

PRICE.—10s. 6d., in Box.

Manufactured by SPONG & Co., High Holborn, London, W.C.

DIVISION C.—CLASS II.—Section 7. Water Closets.

Household Water Closet.

Certificate of Merit, 1889.

To R. W. TOMLINSON.

DESCRIPTION.—The Closet and Trap are made separately in earthenware. The Basin has a flushing rim. The water stands in the Trap, not in the Basin.

PRICES.—White Basin and white Trap, 12s. 3d.; white Basin (printed) and white Trap, 14s. 9d.; white Basin (gold lines) and white Trap, 18s.; Traps with Ventilating Pipe, 9d. extra.

Manufactured by SHARPE BROS. & Co., Swadlincote Potteries; London Office, 76, Finsbury Pavement, E.C.

DIVISION C.—CLASS II.—Section 7. *(Continued.*

Burton Water Closet.

Certificate of Merit, 1889.

To R. W. TOMLINSON.

DESCRIPTION.—The Closet and Trap are made in one piece of earthenware with Flushing-rim, and Trap above Floor-line.

PRICES.—Cane and White, 18s. 9d.; Cane and Printed, £1 2s. 6d.; White, £1 4s. 9d.; White and Printed, £1 8s. 9d.; White and Gold, £1 13s.

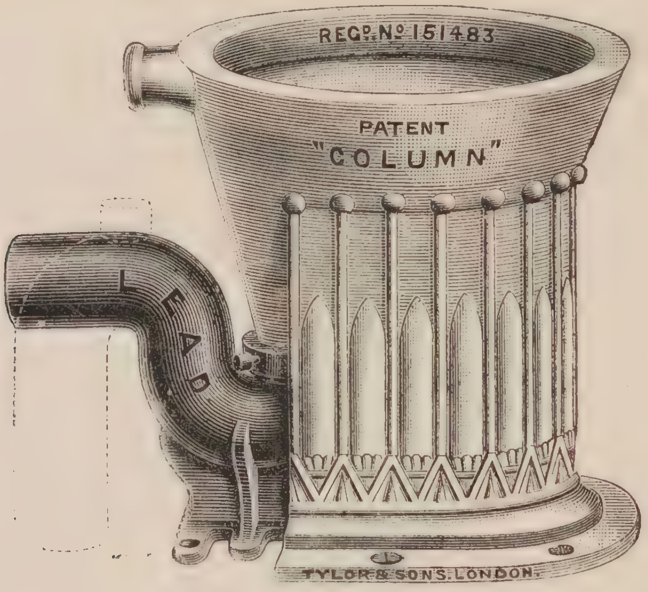
Manufactured by SHARPE BROS. & Co., Swadlincote, Burton-on-Trent.

DIVISION C.-CLASS II.—Section 7. *(Continued.)*

Column Water Closet.

Certificate of Merit, 1890.

To J. TYLOR & SONS, LIMITED.



DESCRIPTION.—This Closet is made with Lead Trap to shoot either out or down. The use of a Lead Trap enables a wiped-joint between the trap and the soil-pipe to be well made. The Lead Trap is joined to the earthenware basin by a brass collar, as in the ordinary Valve closet.

PRICES.—From £1 19s. to £2 12s. 6d.

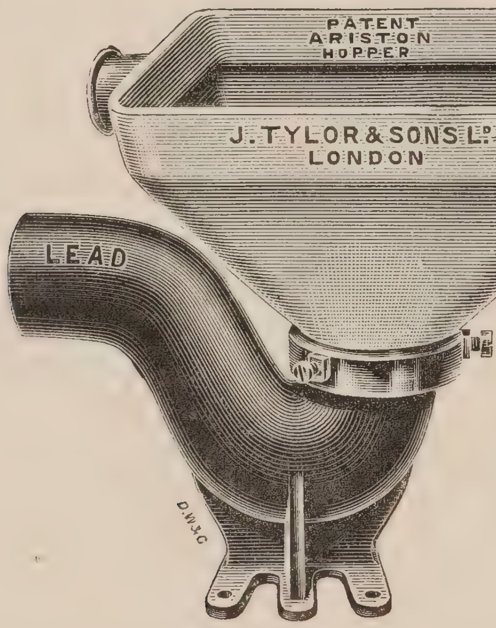
Manufactured by J. TYLOR & SONS, LIMITED, 2, Newgate Street, E.C.

DIVISION C.—CLASS II.—**Section 7.** *(Continued.)*

The "Ariston" Slop-Sink Water Closet.

Medal, 1890.

To J. TYLOR & SONS, LIMITED.



DESCRIPTION.—Square Earthenware Basin with Flushing Rim; separate Reversible Lead Trap, to enable wiped-joint to be made with soil pipe; all fixed above floor line.

SIZES.—Top of basin (outside measure), 14 in. × 16 in.; Outlet (inside measure), $3\frac{1}{2}$ in. Depth of basin, 10 in.; Total height of top of basin above floor when fixed, 17 in.

PRICE OF CLOSET.—White, £2.

Manufactured by J. TYLOR & SONS, LIMITED, 2, Newgate Street, London, E.C.

DIVISION C.—CLASS II.—**Section 7.** *(Continued.)*

Shanks' Tubal Wash-Out Closet.

Certificate of Merit, 1889.

TO J. WARD & SON.

SIZES.—Top of Basin, outside measure, 2 ft.; Outlet, inside measure, $3\frac{1}{2}$ in.; Depth of Basin, 7 in.; Total height of top of Basin above floor when fixed, $17\frac{1}{2}$ in.

PRICES.—Fine Earthenware, White, £2 2s. 6d.; Printed, £2 14s.; Strong Fire-clay, White Enamelled inside and Buff Glazed outside, £1 16s. 6d.

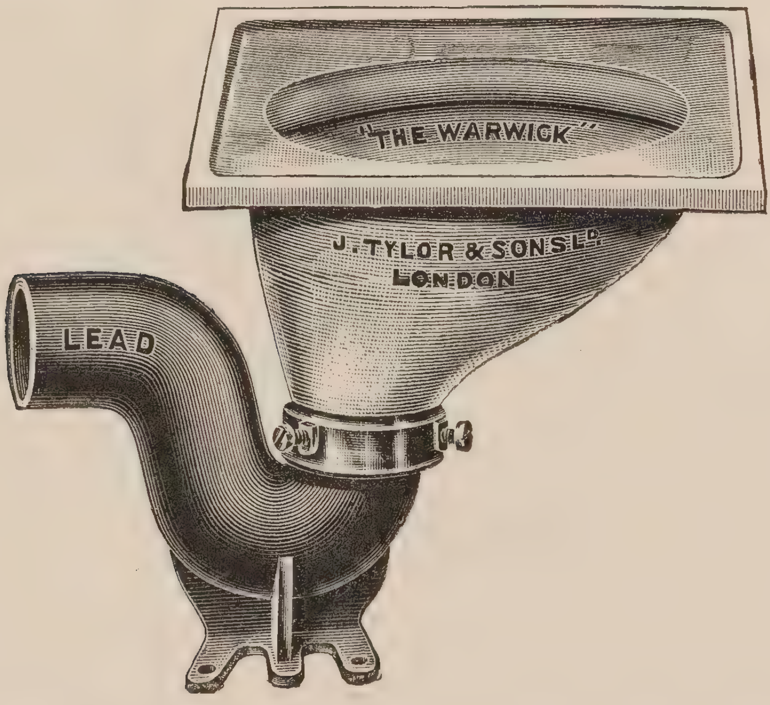
Manufactured by SHANKS & Co., Barrhead, N.B.

DIVISION C.—CLASS II.—Section 7. *(Continued.)*

Warwick Combined Slop Sink and W.C. with Lead Trap.

Certificate of Merit, 1892.

To J. TYLOR & SONS, LIMITED.



DESCRIPTION.—This Slop Sink is made of white earthenware, with lead trap to shoot either out or down. The lead trap is joined to the earthenware basin by a simple brass collar and red lead or putty joint, as in an ordinary valve closet. This joint between earthenware and metal is above the trap, and the whole is above the level of the floor. The water stands higher than the joint between closet and trap.

SIZE.—One size only.

PRICE.—£1 16s.

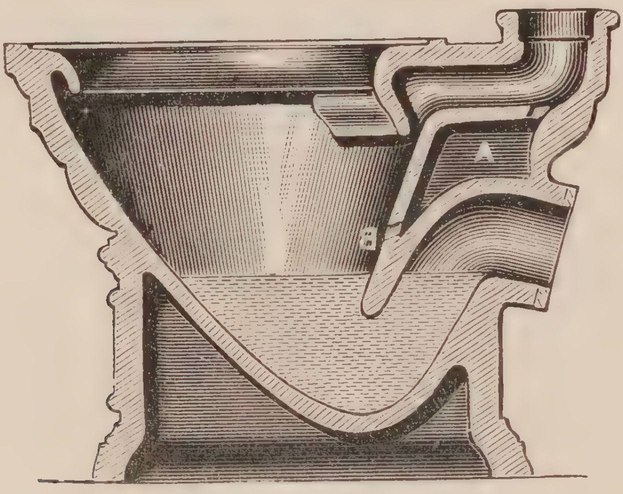
Manufactured by J. TYLOR & SONS, LIMITED, 2, Newgate Street, E.C.; and Belle Isle, York Road, N.

DIVISION C.—CLASS II.—**Section 7.** *(Continued.)*

Shanks' Citizen Combined W.C. and Slop Sink with "P" Trap.

Certificate of Merit, 1892.

TO PORTSMOUTH WATER FITTINGS CO.



DESCRIPTION.—The Basin and Trap are so constructed that a large surface and depth of water is secured in the basin and trap. The special formation and sweep of the trap render it washed out by the flush of water, which, by means of the spreader or fan, washes the basin and falls with force in the centre. To prevent the trap remaining empty if siphoned, a service box is constructed, which catches part of the flush, and allows its contents to percolate through a little hole arranged for the purpose, after the flush is past.

PRICE.—No. 82 Closet, as shown, £2 7s. 6d.; with decorations in colours and gilding, £3 2s. 6d.

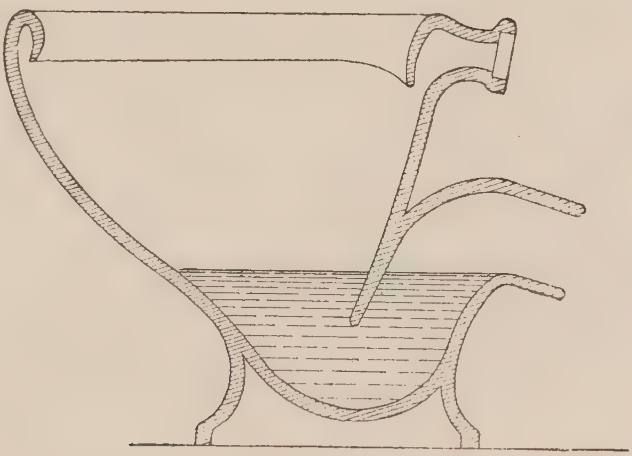
Manufactured by SHANKS & Co., Barrhead, N.B.

DIVISION C.—CLASS II.—**Section 7.** *(Continued.)*

Trident Hopper Water Closet with "P" Trap.

Certificate of Merit, 1892.

To PORTSMOUTH WATER FITTINGS CO.



DESCRIPTION.—The Closet and Trap are made in one piece of Earthenware, with Flushing Rim and Trap above floor line.

PRICES.—Fireclay, £1; Plain White or Ivory Basin, £1 5s.; Printed Pattern £1 16s.

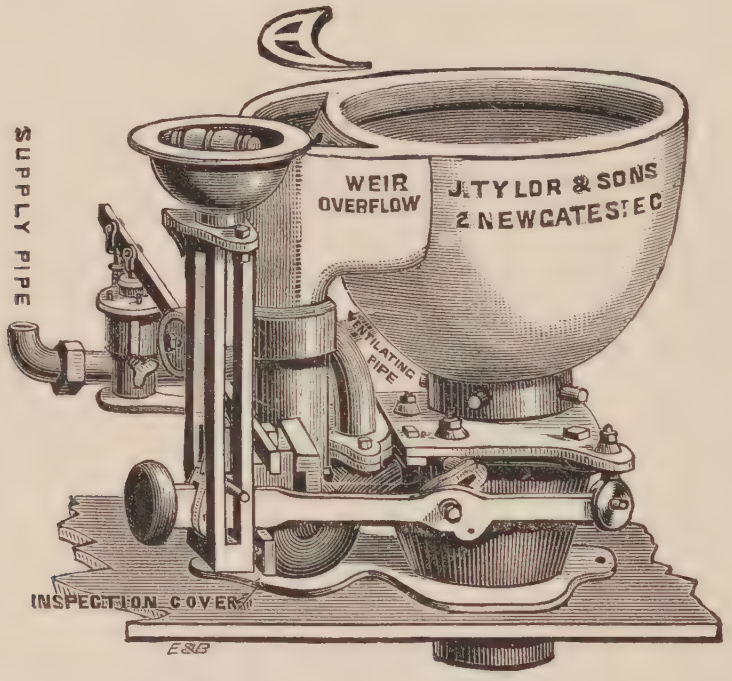
Manufactured by THOMAS W. TWYFORD, Cliffe Vale Pottery, Hanley, Staffordshire.

DIVISION C.—CLASS II.—Section 7. *(Continued.)*

Weir Overflow, Valve Water Closet for Lead Trap.

Certificate of Merit, 1890.

To J. TYLOR & SONS, LIMITED.



DESCRIPTION.—With parallel action adjustable pull, and anti-friction guide; full-sized flushing rim basin, with large Weir overflow, which is flushed each time the handle is raised. This overflow can be examined and cleaned.

SIZES.—Top of Basin, outside measure, 14 in. × 16 in.; Outlet, inside measure, 3½ in; Depth of Basin, 11 in.; Total height of top of Basin above floor when fixed, 17 in.

PRICES.—From £5 2s.

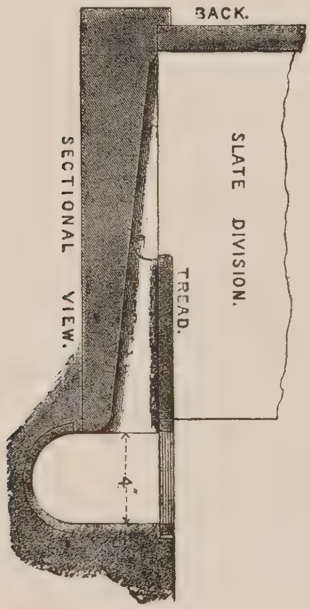
Manufactured by J. TYLOR & SONS, LIMITED, 2, Newgate Street, E.C.

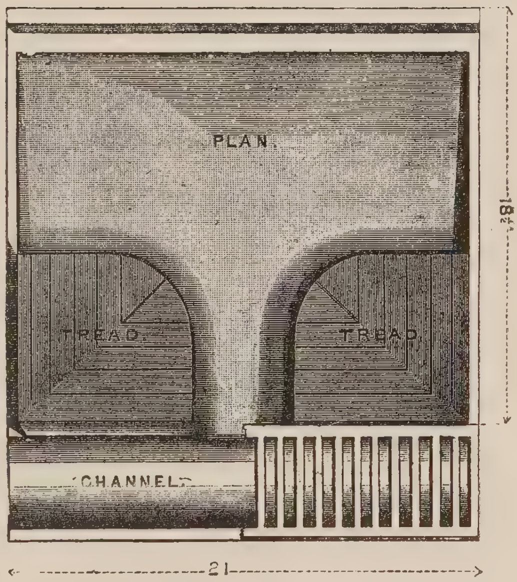
DIVISION C.—Class II.—Section 8. Urinals.

Beancliffe Urinal Base.

Certificate of Merit, 1889.

To J. Cliff & Sons.





Description.—The Bases are independent of the Channel for carrying away the water, and can be set at one and the same level throughout. Every part is accessible for cleaning, and the Channel can be swept out from end to end upon removing the gratings.

Prices.—Single Stall Bases, with Treads, £1 5s.; Double, £2 10s.

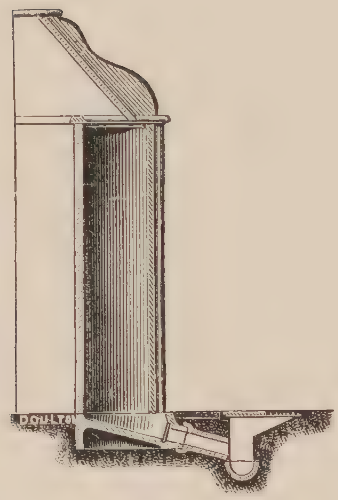
Manufactured by Joseph Cliff & Sons, Wortley, Leeds.

DIVISION C.—CLASS II.—**Section 8.** *(Continued.)*

Special Urinal.

Certificate of Merit, 1890.

To DOULTON & Co.



DESCRIPTION.—The Back forms a segment of a circle, and the Base is well dished, both being made in strong Salt-Glazed Stoneware. A copper Sparge-Pipe is carried round the back (protected by the Slate top), and flushes both Back and Base.

PRICES.—From £7 15s., Single.

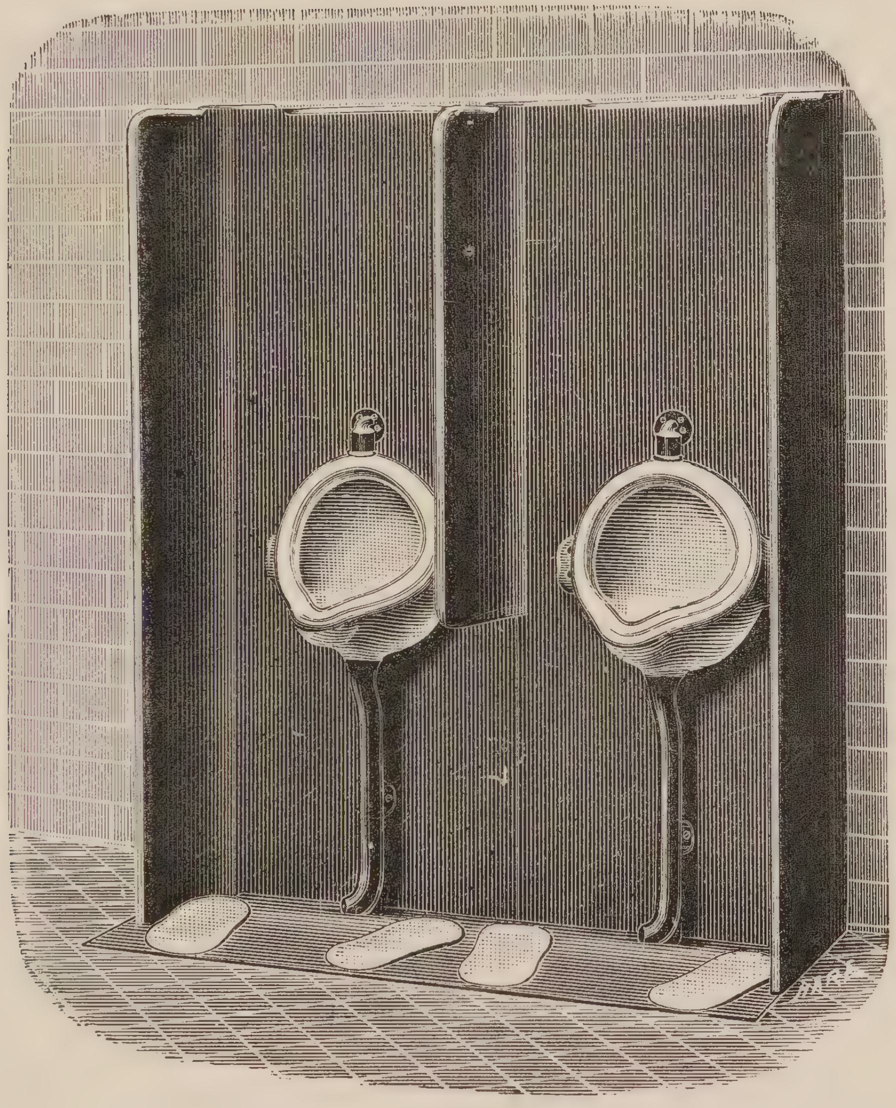
Manufactured by DOULTON & Co., Lambeth.

DIVISION C.—CLASS II.—Section 8. *(Continued.)*

Improved Urinal.

Certificate of Merit, 1890.

To BURN & BAILLIE.



DESCRIPTION.—The Foot-plates, which are placed so that a person using the Urinal is not comfortable unless standing upon them, are intended to keep the user well forward to the basin to ensure its being used, thus avoiding the splashing of urine against the Enamelled Slabs; the outlet gratings of the Basin and of the Channels are movable.

PRICES.—From £6 15s. to £8 10s.

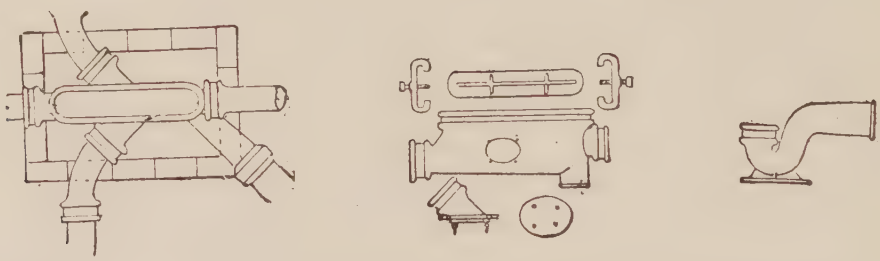
Manufactured by BURN & BAILLIE, 14, Newcastle Street, Farringdon Street, E.C.; BURN BROS., 23 and 24 Charing Cross; 53, Hanover Street; and Edinburgh.

DIVISION C.—CLASS II.—**Section 9. Sewers, Drain Pipes, & Accessories.**

Cast Iron Drain-Pipes, Inspection-Chamber, and Traps.

Certificate of Merit, 1890.

To BURN & BAILLIE.



DESCRIPTION.—They are made of the strength of water-pressure mains, three-eighths of an inch thick; the joints being caulked with yarn and run with molten lead. The Inspection Cap is fixed with Iron Clamps and Screws.

SIZE.—Pipes in 6 ft. lengths.

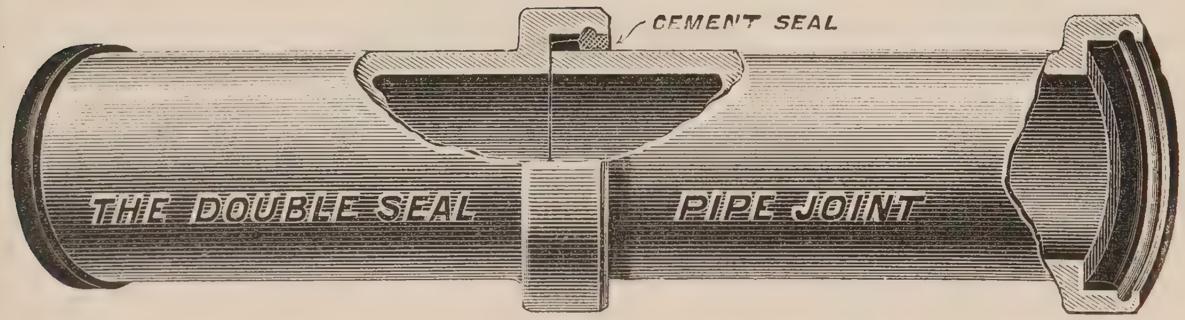
Manufactured by BURN & BAILLIE, 14, Newcastle Street, Farringdon Street, E.C.; and BURN BROS., 23 and 24, Charing Cross, S.W.

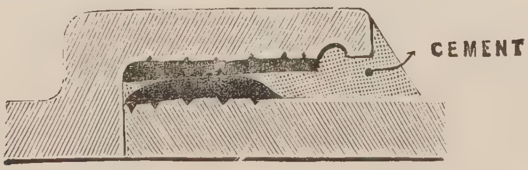
DIVISION C.—CLASS II.—Section 9. *(Continued.)*

Double Seal Pipe Joints.

Medal, 1890.

To JOSEPH CLIFF & SONS.





DESCRIPTION.—These pipes are similar to the Stanford jointed pipes, but have in addition a deeper and undercut socket, so that after the pipes have been laid and tested, an ordinary cement joint can be made in addition to the Stanford joint.

SIZES.—4 in., 6 in., 9 in., 12 in., 15 in., 18 in. diameter.

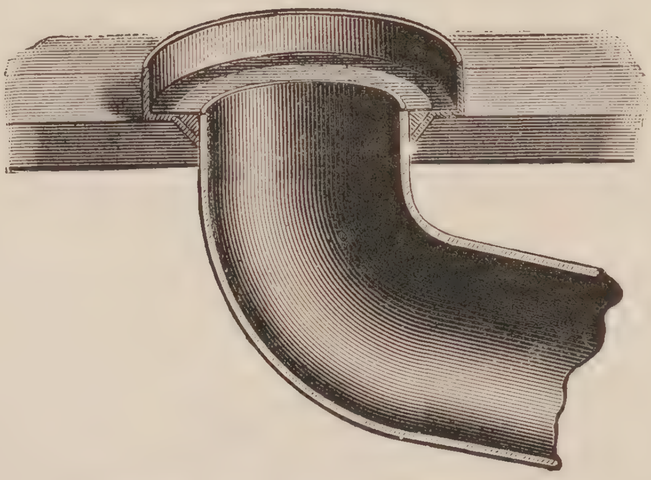
PRICES.—7d., 10d., 1s. 3½d., 2s. 1d., 3s. 4d., 4s. 6d. per foot.

Manufactured by JOSEPH CLIFF & SONS, Wortley, Leeds.

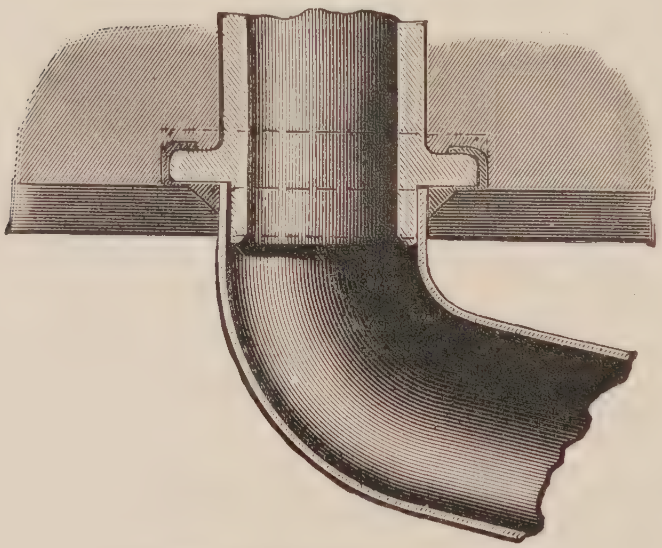
Collar Joint for connection of Soil-Pipe to Water-Closet.

Certificate of Merit, 1890.

To BOSTEL BROS.



Showing Joint ready to receive W.C.



Showing Joint with Closet in place.

DESCRIPTION.—The Lead Collar is wiped with plumbers' metal to the Soil-Pipe and then bossed over the flange of the trap, the closet being previously bedded in the usual way.

PRICE.—From 2s. 6d.

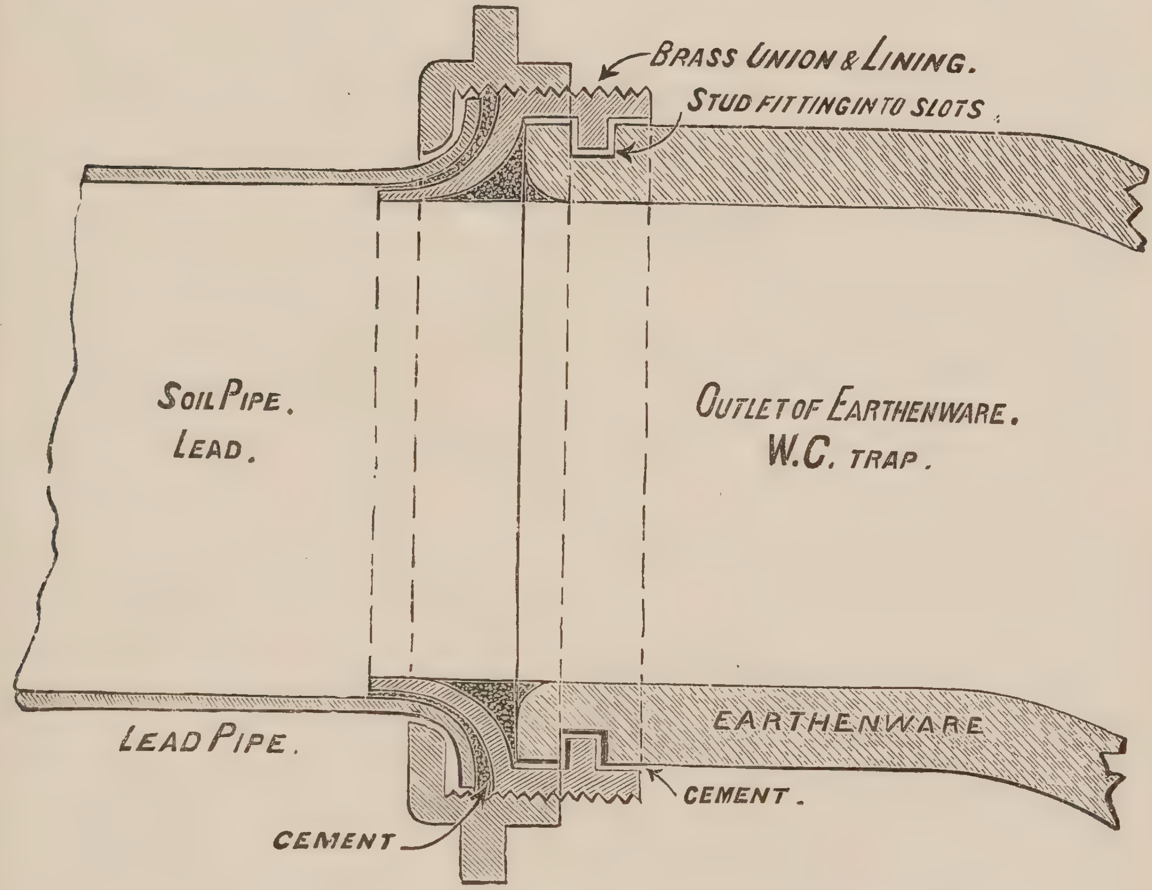
Manufactured by BOSTEL BROS., Brighton.

DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Union Joint for Connection of Soil-Pipe to Water-closet.

Certificate of Merit, 1890.

To D. T. BOSTEL.



DESCRIPTION.—This Joint is for the purpose of connecting an earthenware P trap with a lead soil-pipe. It is made in Brass-work, and consists of two parts, one of which fits on to the outlet of the trap and is fixed by three Studs cast on the inside which slip into Grooves made in the earthenware, and by a half-turn it is fixed. The other part forms a Cap with a Female Thread to fit a Male Thread on the first part, after this part is fixed to the Trap. To make the Joint slip the Cap on to the soil-pipe, which is then opened with a Tan Pin and painted inside. The water-closet is then placed in position and the whole screwed up, the Joint being above the floor. Cement used: Red lead and gold size cement.

PRICE.—11s. each.

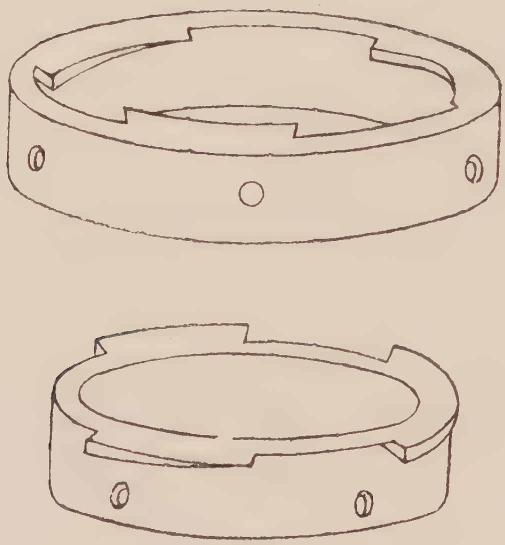
Manufactured by D. T. BOSTEL & SON, 73, Ebury Street, London, S.W.

DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Bayonet Joint for Connecting Closet Basin to Metal Pipe.

Certificate of Merit, 1892.

TO PORTSMOUTH WATER FITTINGS CO.



DESCRIPTION.—Consists of two metal flanges made to fix with wedge-shaped ribs on outside of smaller flange and on inside of the large flange, tightening the joint like the thread of a screw.

PRICES.—Cast Iron, 3s. 6d. and 4s. 6d.; Brass, 10s.

Manufactured by THOMAS W. TWYFORD, Cliffe Vale Pottery, Hanley, Staffordshire.

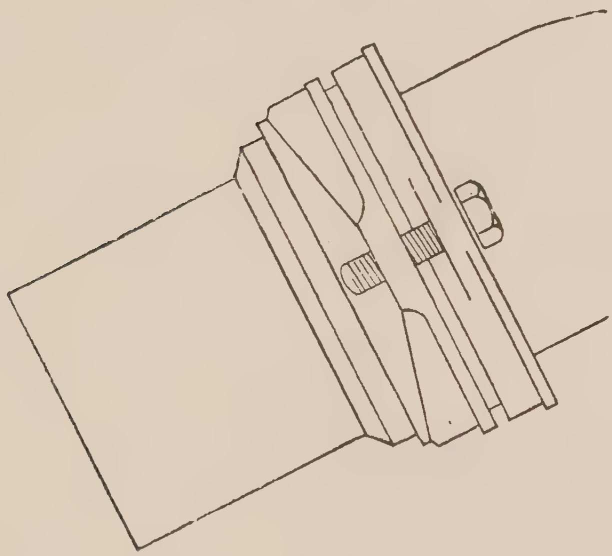
DIVISION C.—Class II.—**Section 9.** *(Continued.)*

Joint for Connecting Closet Basin to Metal Pipe.

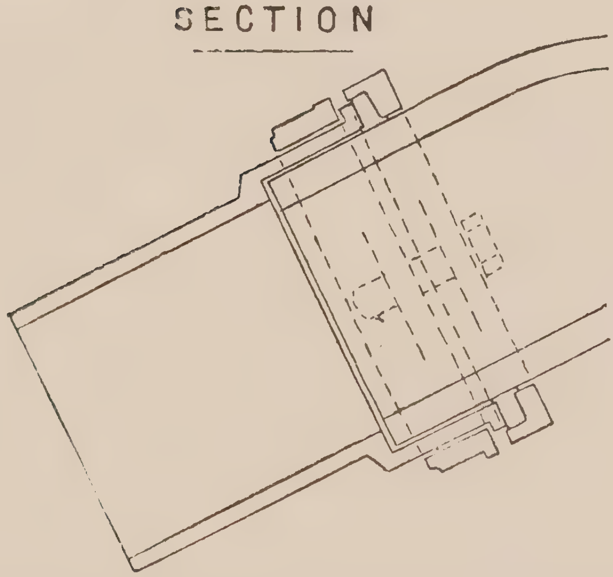
Certificate of Merit, 1892.

To G. Jennings.

ELEVATION.



SECTION



Description.—The joint is made with an India-rubber Ring, which is tightly compressed against the flange of the lead soil pipe and the earthenware trap by means of two galvanised-iron collars, which are placed one above and the other below the ring and drawn together by two screw bolts.

Price.—From 10s.

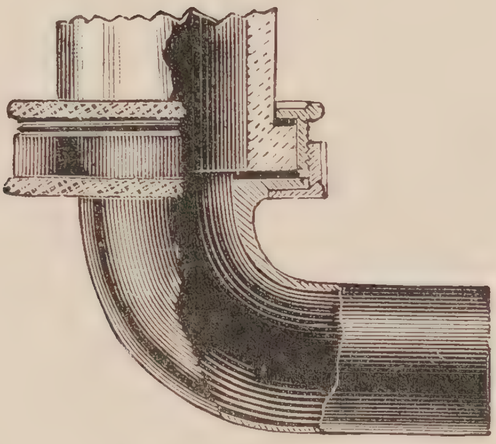
Manufactured by G. Jennings, Stangate, London, S.E.

DIVISION C.—CLASS II.—Section 9. *(Continued.)*

Union Joint with Divided Gland for Coupling Flush Pipe with Basin of W.C.

Certificate of Merit, 1892.

To QUIRK & SHARP.



DESCRIPTION.—This connection consists of a split collar threaded on the outer surface, which is placed round the flush inlet immediately behind the beading. Over this is screwed up an ordinary union carrying a brass bend flanged at the bottom. Between the face of the brass bend and the earthenware inlet a rubber washer is inserted.

SIZES.—Various.

PRICE.—7s. 6d.

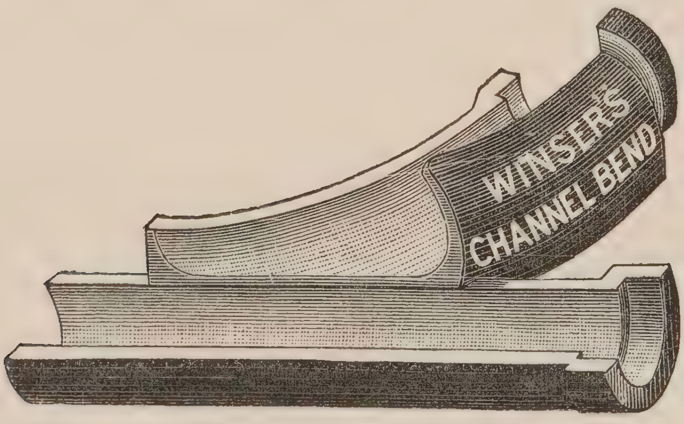
Manufactured by QUIRK & SHARP, 31, Islington, Liverpool.

DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Enamelled Drain Channels.

Certificates of Merit, 1889 and 1890.

To WINSER & Co., and J. CLIFF & SONS.



DESCRIPTION.—The outer side is carried higher than the inner, and curved over, so that the sewage, as it rises in passing round the bend, is concentrated and folded over like a wave, and turned in the direction of the out-go. They are all made with sockets and a broad flat rebated base.

SIZES.—4 in., 6 in., and 9 in. (straight channels).

PRICES.—2s., 2s. 8d., and 4s. each.

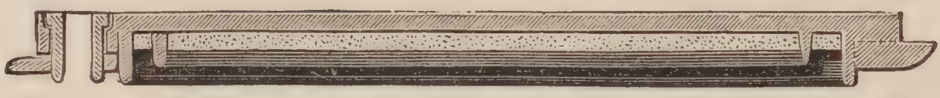
Manufactured by WINSER & Co., 52, Buckingham Palace Road, S.W.

DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Improved Air-tight Manhole Cover.

Certificate of Merit, 1889.

To A. T. ANGELL.



This cover, although removable, is locked and firmly fastened when closed.

SIZES.—16 in. × 14 in. up to 3 ft. × 2 ft.

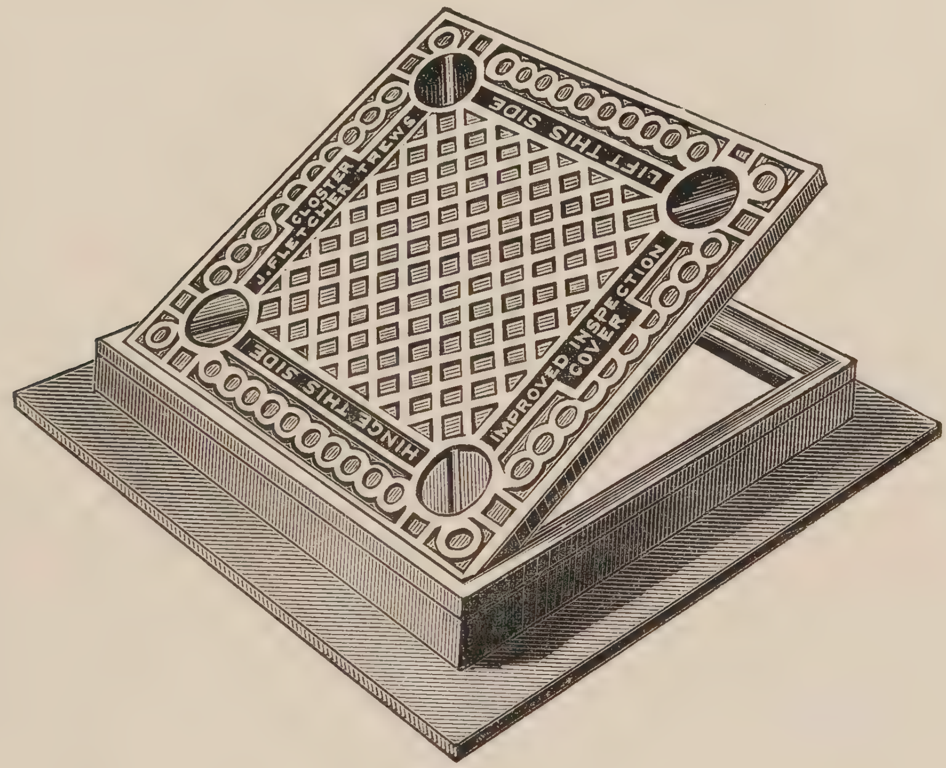
Manufactured by A. T. ANGELL, 2, Drayton Gardens, S.W.

DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Trew's Manhole Cover.

Certificate of Merit, 1889.

TO THE SANITARY AND ŒCONOMIC ASSOCIATION, LIMITED.



DESCRIPTION.—This is made in two parts; one forms the frame, which is a fixture; the other the movable cover, which is without hinge. The cover consists of a casting 18-inch square, having a flange on each side. When the cover is closed, the flange fits into a corresponding groove in the frame. One of these flanges is rounded and forms a substitute for a hinge. It is made air-tight by filling the groove with grease.

SIZE.—18 in. × 18 in.

PRICES.—Black Iron, £1 2s.; Galvanised, £1 15s.

Manufactured by THE SANITARY AND ŒCONOMIC ASSOCIATION, LIMITED, Gloucester.

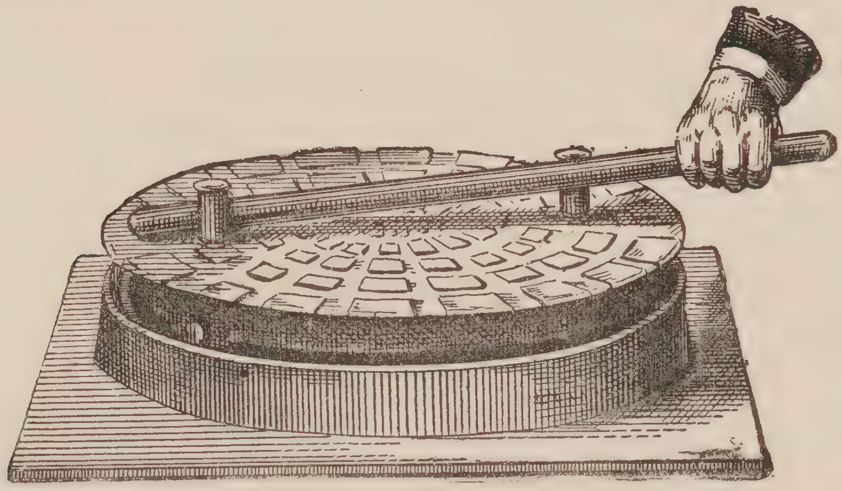
Durrans' Metallic Jointed Air-Tight Cover.

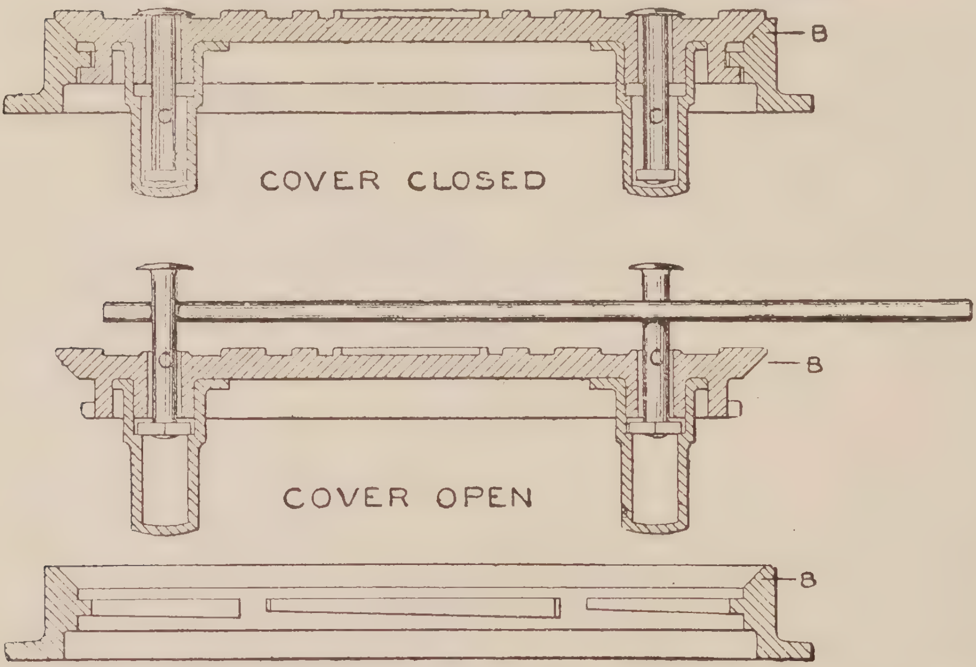
Certificate of Merit, 1889.

Manhole Cover with Metal-faced Joint.

Certificate of Merit, 1890.

To H. DEAN and T. H. DURRANS & Co.





DESCRIPTION.—The Cover and Frame have truly turned and ground bevelled faces **B**, which are brought together by a bayonet joint fastening (with ribs and inclined planes). To open the Cover the two drop handles **C** are raised, and a bar of iron serves as a lever to turn the Cover. It is locked when down, and cannot be opened without the lever.

SIZES.—18 in., 20 in., and 24 in. diameter.

PRICES.—£2, £2 10s., and £2 15s.; Locking extra.

Manufactured by HOUSE SANITATION COMPANY, 15A, Upper Baker St., N.W.

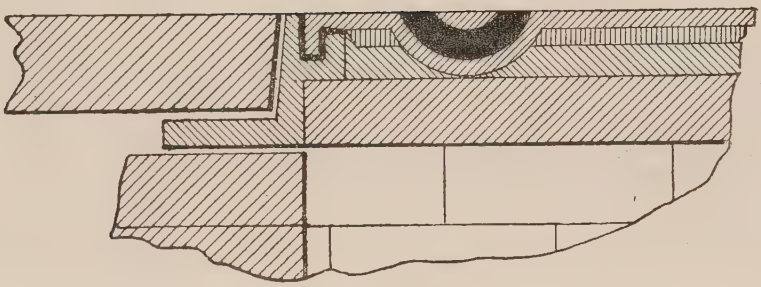
DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Air-tight Manhole Cover.

Certificate of Merit, 1889.

To WINSER & Co.

No. 1.



DESCRIPTION.—The Covers are made with a grooved joint all round, as shown in the section, which can be filled with oil or glycerine, or fitted with india-rubber packing. They are made with two forms of outer flange. The one shown is generally used when the Cover is fitted in concrete or similar paving.

SIZES.—1 ft. 10 in. × 1 ft. 4 in. to 3 ft. 6 in. × 2 ft. 6 in.

PRICES.—15s. to £3 3s. each.

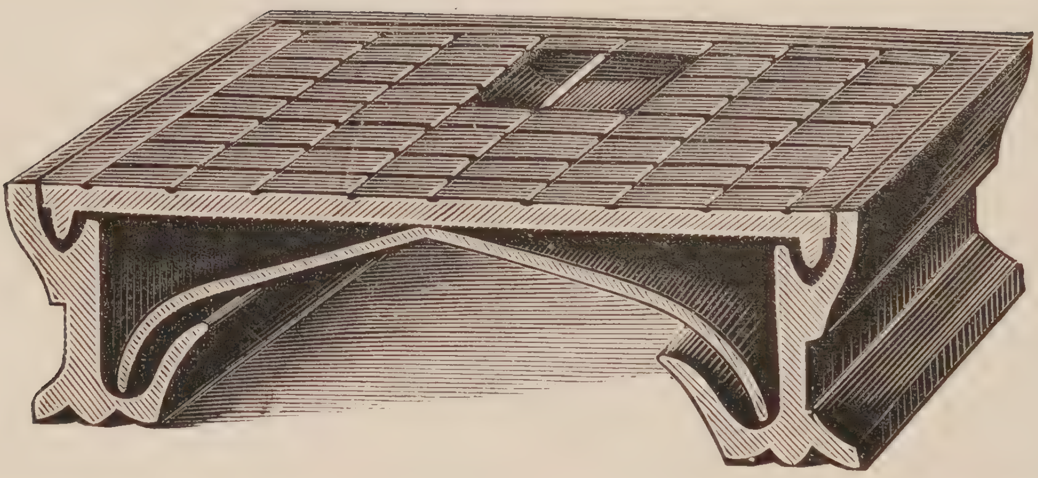
Manufactured by WINSER & Co., 52, Buckingham Palace Road, S.W.

DIVISION C.—Class II.—**Section 9.** *(Continued.)*

Manhole Cover for Drains.

Certificate of Merit, 1890.

To John Jones.



Description.—The Inner Cover is arched, which allows the moisture from the drain, which condenses on it, to run down to the Groove, into which the Cover fits, and thus makes an air-tight joint. The top Cover is flat with the surface of the ground, and also fits into another groove that may be filled with any suitable material, thus forming a second seal. Where required the Covers are made in one piece.

Size.—23 in. × 13½ in., 24 in. × 17in., 26 in. × 20 in., 27½ in. × 18½ in., 34½ in. × 22½ in., 36 in. × 20 in., 57 in. × 39 in.

Price.—From £1 7s.

Manufactured by John Jones, 40, Sydney Street, Chelsea.

White Enamelled Straight and Curved Channels for Inspection Chambers to Drains.

Certificate of Merit, 1892.

To BROAD & Co.

DESCRIPTION.—These are designed for use in Inspection Chambers.

SIZE.—4 in., 6 in., and 9 in.

Manufactured by BROAD & Co., South Wharf, Paddington, W.

Tyndale's Rock Concrete Manhole for Sewers and Drains.

Certificate of Merit, 1892.

To PORTSMOUTH WATER FITTINGS Co.

DESCRIPTION.—Made in Rock Concrete Rings in sections to enable manholes of any depth to be constructed cheaply and quickly.

PRICES.—From 6s. 6d. per foot.

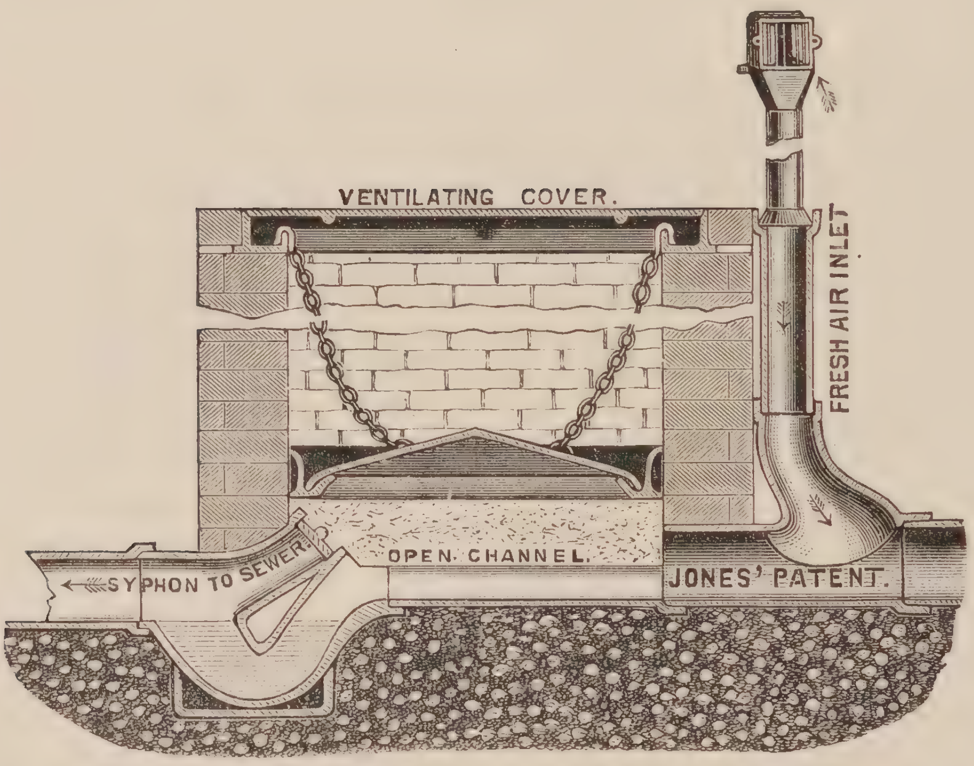
Manufactured by HENRY SHARP, JONES, & Co., LIMITED, Bourne Valley Works, Poole.

DIVISION C.—CLASS II.—**Section 9.** *(Continued.)*

Condensation Seal Cover for Bottom of Manholes.

Certificate of Merit, 1892.

To JOHN JONES.



DESCRIPTION.—Intended for bottom of deep Manholes, to be fixed about one and a half feet above open channel, thus limiting the space in which foul gases can accumulate.

SIZE.—26 in. × 20 in. and 36 in. × 24 in.

PRICE.—25s. and 35s. Galvanised Chain and hooks 1s. per lb.

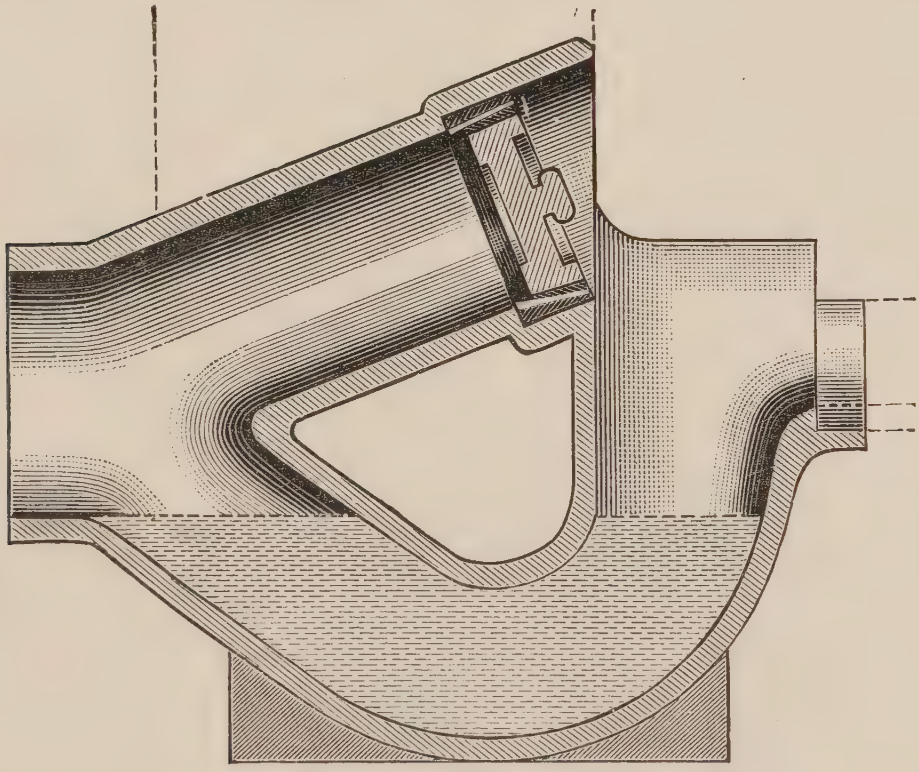
Manufactured by JOHN JONES, 40, Sydney Street, Chelsea, S.W.

DIVISION C.—CLASS II.—**Section 10. Traps and Gulleys.**

"Beancliff" Disconnecting Trap.

Certificates of Merit, 1889 and 1890.

TO JOSEPH CLIFF & SONS.



SIZES.—4 in., Brown Glaze inside and outside (4 in. Inlet and Waterway, 6 in. Outlet); 6 in., Brown Glaze inside and outside (6 in. Inlet and Outlet, $5\frac{1}{4}$ in. Waterway); 4 in., White Glaze outside, White inside; 6 in., White Glaze outside, White inside.

PRICES.—8s., 10s. 6d., 12s., and 15s. each.

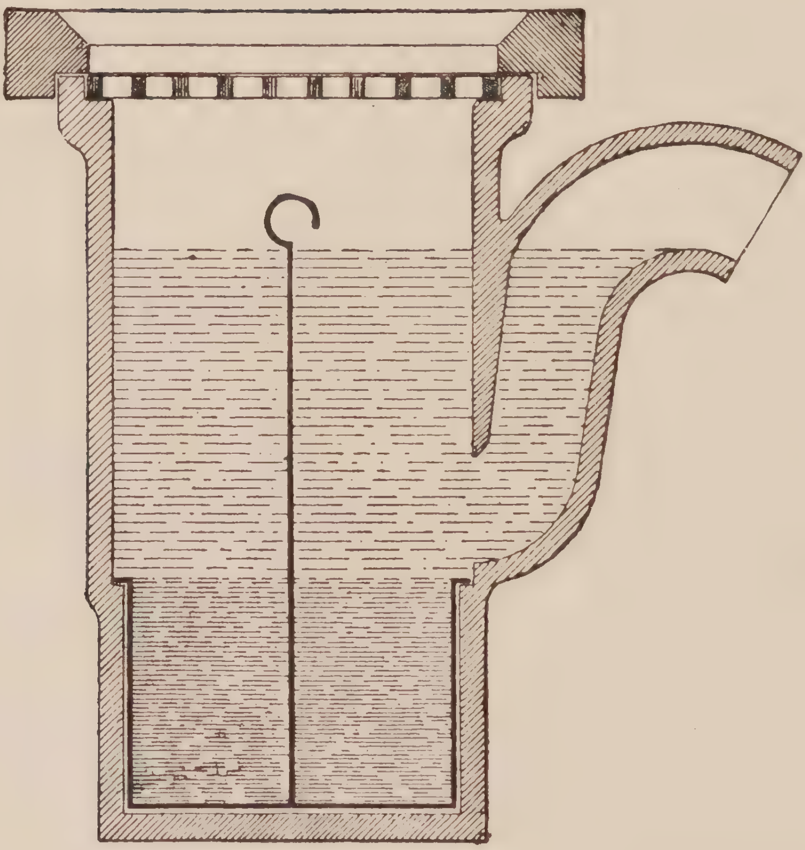
Manufactured by JOSEPH CLIFF & SONS, Wortley, Leeds.

DIVISION C.—CLASS II.—Section 10. *(Continued.)*

Dean's Silt Gully.

Certificate of Merit, 1889.

To H. DEAN.



DESCRIPTION.—This Trap is made in two parts, the outer part is made of Stoneware, and the receptacle inside of Galvanised Iron. The receptacle is so placed in the Trap that no solid matters can rest anywhere but in the receptacle, which can be removed and cleaned.

SIZES.—6 in. to 18 in. circular.

PRICES.—From 7s. to £2 each.

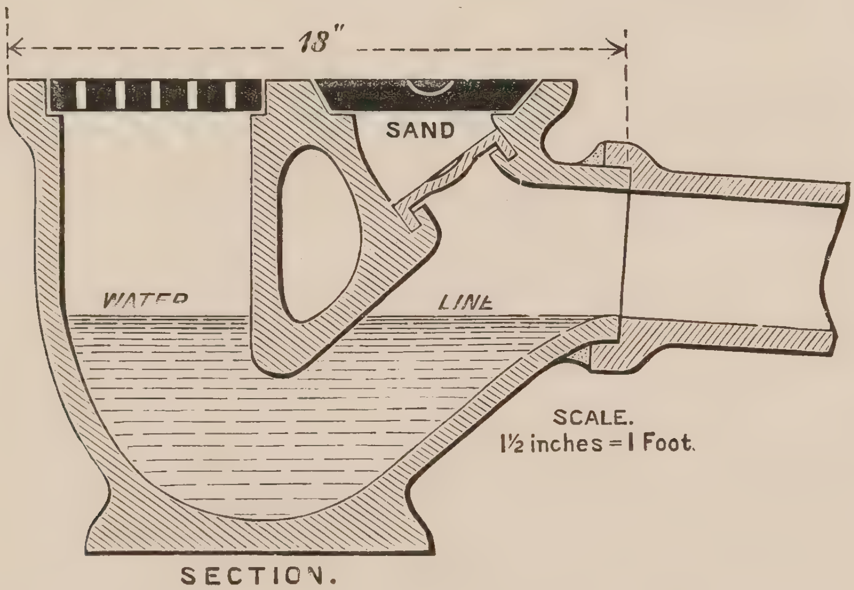
Manufactured by J. C. EDWARDS, Terra Cotta Works, Ruabon.

DIVISION C.—CLASS II.—**Section 10.** *(Continued.)*

"Stokes" Gully Trap.

Certificates of Merit, 1889 and 1890.

To WINSER & Co. and J. CLIFF & SONS.



DESCRIPTION.—This Trap affords ready means of access to the outer side of Trap. The Inspection Cap, which has a double cover, allows the drain to be inspected without the necessity of breaking the Trap or pipes.

PRICE.—In Brown-ware, with painted Grid and Plate (4 in.), 12s. 6d.

Manufactured by J. CLIFF & SONS, Wortley, Leeds.

Brass Traps for Baths and Sinks.

Certificate of Merit, 1890.

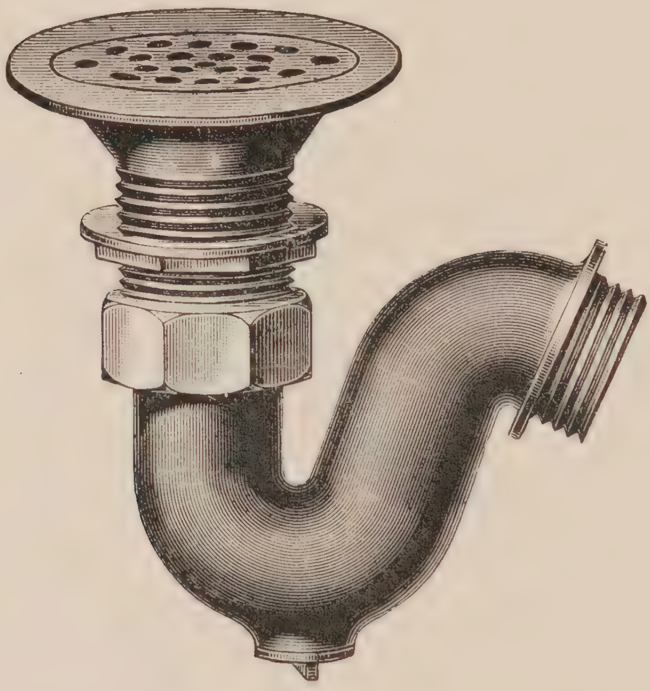
To BURN & BAILLIE, 14, Newcastle Street, Farringdon Street, E.C.

DIVISION C.—CLASS II.—**Section 10.** *(Continued.)*

Brass Siphon Traps.

Certificate of Merit, 1892.

TO MILNE, SONS & MACFIE.



DESCRIPTION.—Brass Scullery Sink Outlet with Bell mouth and movable Flush Grating, union and jam nut for fixing under sinks, brass trap with cleansing screw, outlet end of Trap screwed male for iron barrel, or with caps and lining for lead pipe.

SIZES.— 1½ in. and 2 in.

PRICES.— 15s., and 17s.

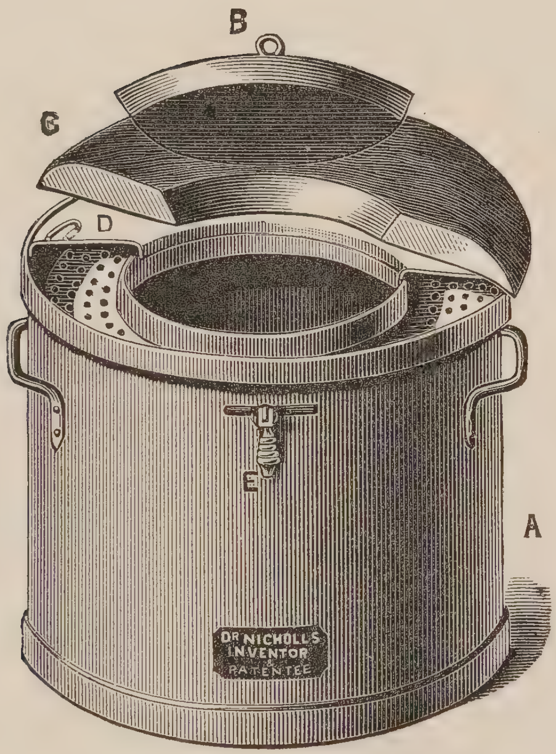
Manufactured by MILNE, SONS & MACFIE, 60, Holborn Viaduct; and JAMES MILNE & SON, LIMITED, Milton House Works, Edinburgh.

DIVISION C.—CLASS II.—**Section 11. Dry Closets.**

Nicholls' Eclipse Soot and Salt Closet.

Medal, 1889

To H. DEAN.



DESCRIPTION.—The Container **A** of the Closet is made of Galvanized Iron fitted with a Metal Tray **D**, which works upon a Ring inside of the Closet Pan, and within an inch of the top of the Closet. The Tray is perforated all over the bottom, and contains Antiseptic Mixture for the deodorization of fæcal matter. By the action of the Tray **D**, the Antiseptic Mixture is showered all over the contents of the Pan **A**. The accurate fitting of the Cover **B** on the Hole of the Seat **C** prevents the Antiseptic Mixture lodging on the top of the Seat.

SIZE.—Diameter 18¾ in., depth 15¾ in.

PRICES.—From £1 19s. to £3.

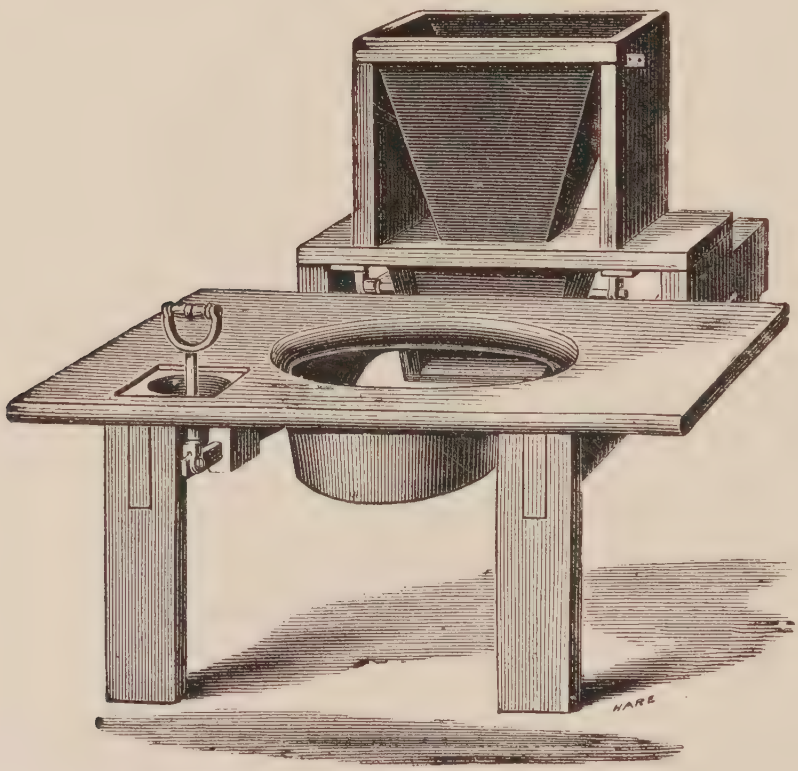
Manufactured by NICHOLLS & Co., 289, Strand, W.C.

DIVISION C.—CLASS II.—**Section 11.** *(Continued.)*

Moule's Earth Closets.

Medals, 1890 and 1892.

To MOULE'S PATENT EARTH CLOSET COMPANY, LIMITED.



DESCRIPTION.—The Receptacle at the top is intended for fine earth, which is used as a deodorant. A Pail is placed under the Seat, and when the handle is pulled up a certain amount of earth is thrown into this pail.

PRICES.—From £1 5s. to £8 10s.

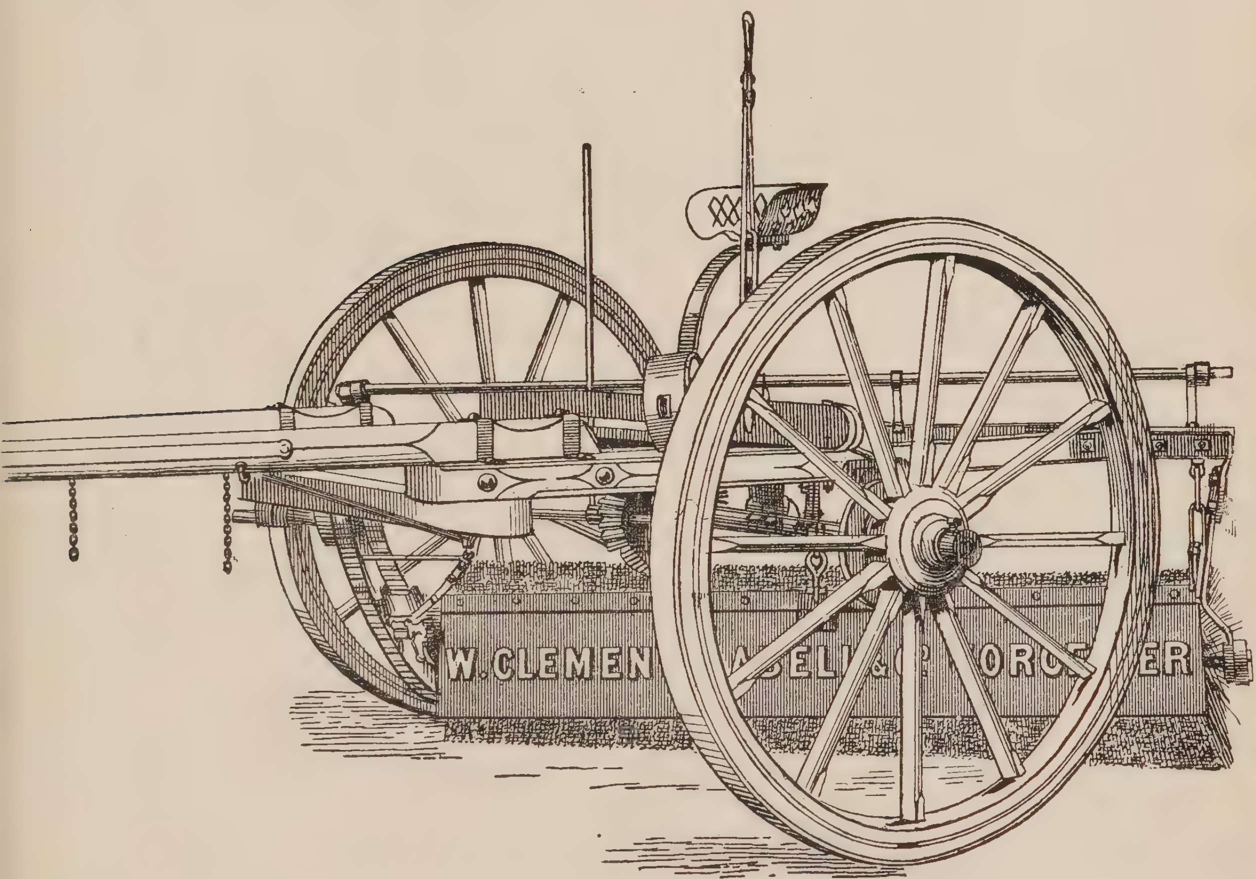
Manufactured by MOULE'S PATENT EARTH CLOSET COMPANY, LIMITED, 5A, Garrick Street, Covent Garden, London, W.C.

DIVISION C.—CLASS II.—**Section 13. Miscellaneous Sanitary Goods.**

Street-Sweeping Machine.

Medals, 1889 and 1890.

To W. CLEMENS ABELL & Co.



DESCRIPTION.—The Brushes are made in six sections and interchangeable. The Spindle on which the Brushes are placed is jointed, so that the Brushes adjust themselves to the hollows in the roads. Made with bent shafts to level the action of the machine. Foot lever for throwing Brush in and out of gear.

SIZES.—Wheel, 4 ft. 8 in. high ; tyres, 3 in. wide ; brushes, 7 ft. long.

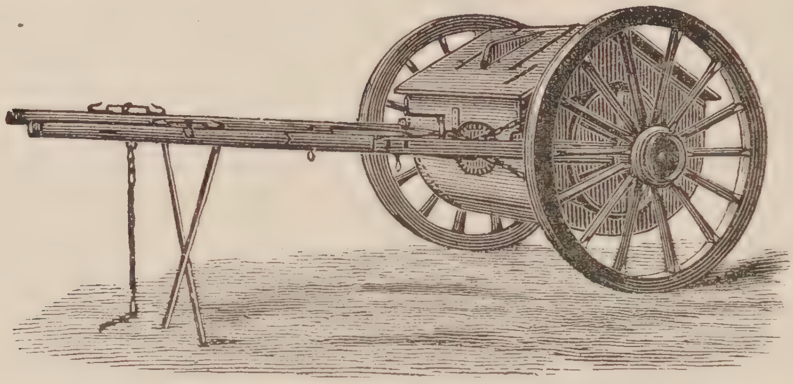
PRICE.—£36.

Manufactured by W. CLEMENS ABELL & Co., Worcester Wagon Works, Worcester.

Improved Tumbler Cart.

Certificate of Merit, 1889.

To W. CLEMENS ABELL & Co.



DESCRIPTION.—This Cart is made to nearly balance when full, and can be easily turned completely over.

SIZES.—To hold 150 Gallons, 200 Gallons, 260 Gallons.

PRICES.— £24 10s., £26, £28.

Manufactured by W. CLEMENS ABELL & Co., Worcester Wagon Works, Worcester.

Improved Tumbler Sanitary Cart.

Certificate of Merit, 1892.

To COLEMAN & MORTON.

DESCRIPTION.—The Body Plate is made of stout steel, swings on a strong frame behind the axles, and is free from obstruction inside. The chain-tipping arrangement will turn the body entirely over or fix it at any required angle.

SIZES.— 100, 150, 200, and 280 gallon capacity.

PRICES.—£19, £23, £28, and £32.

Manufactured by COLEMAN & MORTON, Chelmsford.

DIVISION C.—CLASS II.—**Section 13.** *(Continued.)*

Watlings and Abell's Tip Wagon for Scavengers.

Certificate of Merit, 1889.

To W. CLEMENS ABELL & CO.

DESCRIPTION.—This Van is built so that the load is equally distributed over the four wheels. It is hung on springs. The body is arranged so that it can easily be moved over a frame on which are fixed six rollers, until the weight causes it to tip itself.

SIZES.—8 ft. × 4 ft. × 2 ft. 4 in. deep.

PRICE.—£50.

Manufactured by W. CLEMENS ABELL & CO., Worcester Wagon Works, Worcester.

Air-tight Soil Pail.

Certificate of Merit, 1889.

To W. BENNETT & CO., Worcester.

Fancy Stationery, Bindings, and Machine Rulings.

Certificate of Merit, 1890.

To J. BEAL & SON.

Manufactured by J. BEAL & SON, 55, East Street, Brighton.

DIVISION C.—CLASS II.—Section 13. *(Continued.)*

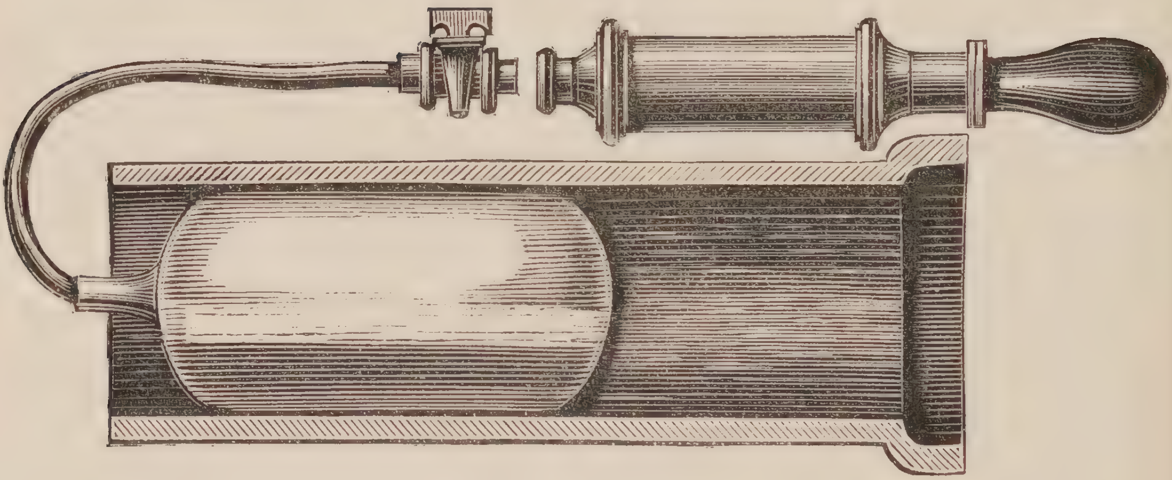
Drain Stopper.

Certificate of Merit, 1890.

Bag Drain and Pipe Stopper.

Certificate of Merit, 1892.

To JOHN JONES.



DESCRIPTION.—The Stopper consists of a cylindrical-shaped Bag, which is placed in the pipe and inflated with a small Air-Bellows or Pump, for stopping pipes for the purpose of testing, &c.

SIZES.—Made for 4 in., 6 in., 9 in., 12 in., 15 in., and 18 in. pipes.
PRICES.— £1, £1 2s., £1 8s. 6d., £1 18s. 6d., £2 8s. 6d., £2 18s. 6d. £3 3s. per set complete. Air Inflators 4s. and 5s. 6d. each. Set, comprising 4 in., 6 in., 9 in., and Best Inflator, £3 8s.

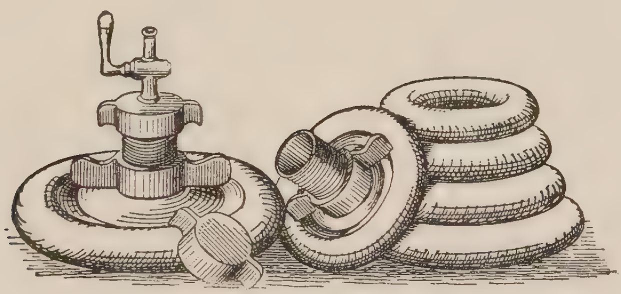
Manufactured by JOHN JONES, 40, Sydney Street, Chelsea.

DIVISION C.—CLASS II.—**Section 13.** *(Continued).*

India Rubber Expanding Plug for Drain Testing.

Certificate of Merit, 1890.

To BURN & BAILLIE.



DESCRIPTION AND USE.—These are used for plugging up drains and for testing either with water, smoke, or other tests. Instead of having a bolt and nut by which to draw up the flanges a brass tube and nut are used, to which an india-rubber tube can be connected.

They are made in sets comprising two sizes of brass flanges and six moulded india-rubber rings (with which any sized pipe from 3 in. to 6½ in. diameter may be plugged), and one test cock.

SIZES.—3, 4, 4½, 5, 6, 6½ inches.

PRICE COMPLETE.—£1 14s. per set. 9 in. expanding plug with test cock, £1.

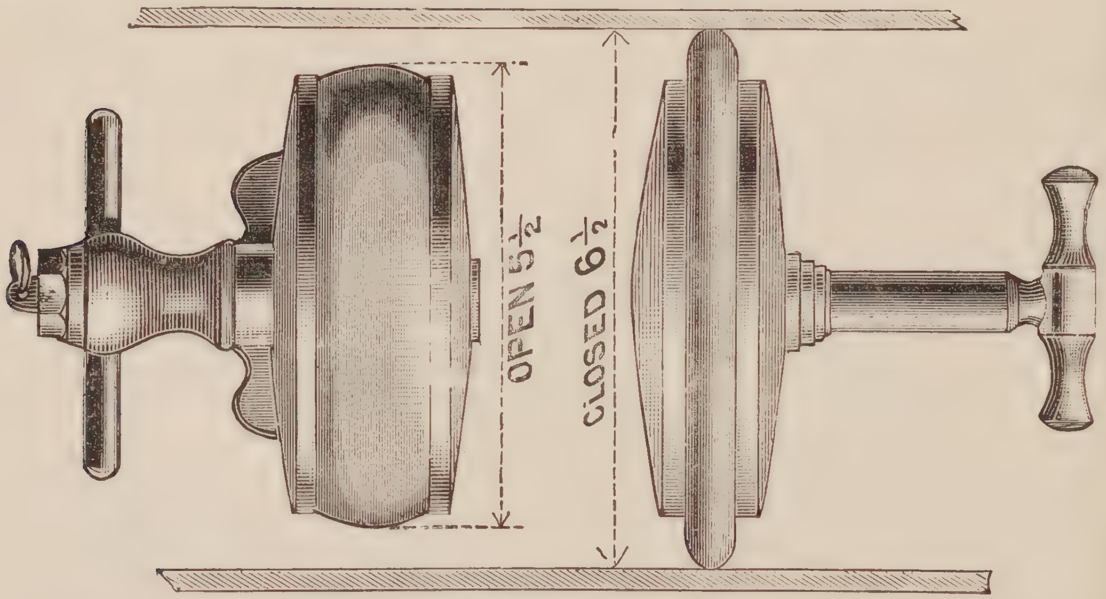
Manufactured by BURN BROTHERS, 24, Charing Cross, S.W., and BURN AND BAILLIE, Newcastle Street, Farringdon Street, E.C.

DIVISION C.—Class II. **Section 13.** *(Continued.)*

Expanding Screw Drain and Pipe Stopper.

Certificate of Merit, 1892.

To John Jones.



Description.—This Stopper consists of two galvanized iron plates or discs, between which a hollow rubber ring of special construction is fixed by means of grooves in the plates. It is screwed up by a **T** handle, the rubber expanding quite an *inch*. Made with or without outlets.

Sizes.—	4 in.,	5 in.,	6 in.,	9 in.,	12 in.
	8s.,	10s.,	12s.,	18s.,	28s.

Price of Complete Set.—£3 16s.

Manufactured by John Jones, 40, Sydney Street, Chelsea, S.W.

DIVISION C.—CLASS II.—**Section 13.** *(Continued.)*

Adjustable Gradient Indicator.

Certificate of Merit, 1890.

To THOMAS JAMES MOSS FLOWER.

DESCRIPTION.—For the purpose of laying drain pipes at a given inclination. Generally used in conjunction with straight edge.

SIZES.—About 10 to 15 inches long.

PRICES.—A	Pattern,	£2 15s. 0d.	C	Pattern,	£1 1s. 0d.
B	,,	£1 17s. 6d.	D	,,	£1 10s. 0d.

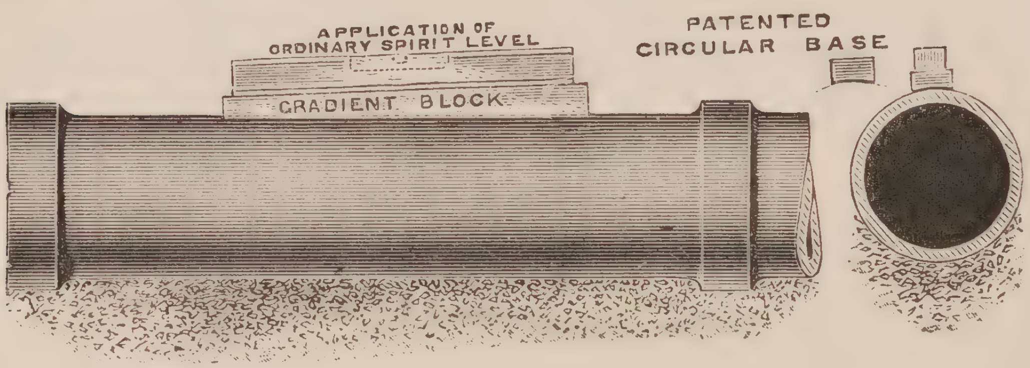
Manufactured by T. J. MOSS FLOWER, Carlton Chambers, Bristol.

DIVISION C.—CLASS II.—Section 13. *(Continued).*

Indicating Gradient Blocks.

Certificate of Merit, 1890.

To THE SANITARY AND DOMESTIC ENGINEERING COMPANY.



DESCRIPTION AND USE.—Wedge-shaped Blocks made for placing on Drain-pipes, for the purpose of laying them at a given inclination with the aid of an ordinary spirit level.

SIZES.—Made in sets consisting of one block, 11 inches long, of each of the following gradients: one inch in 12, 15, 18, 24, 30, 36, 42, 48, 54, 60, and 70 inches.

PRICE.—£3 3s. per set, in case.

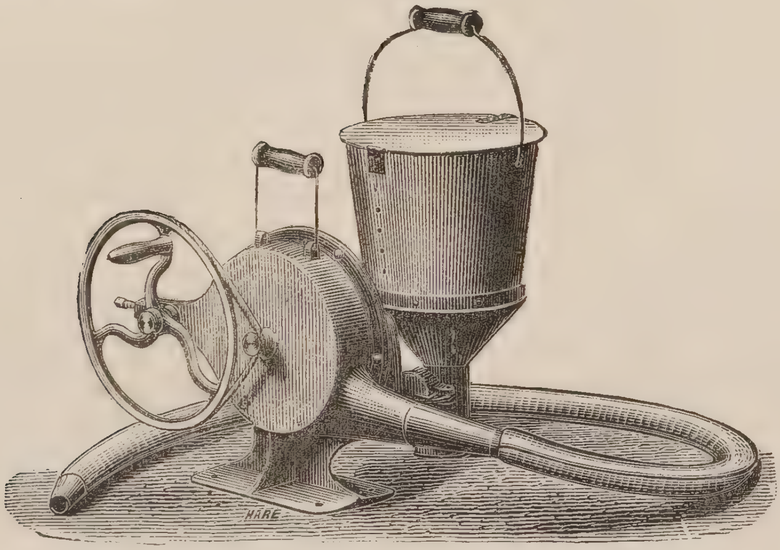
Made by IRWIN C. WALLAS.

DIVISION C.—Class II.—**Section 13.** *(Continued.)*

Watts' Asphyxiator for Testing Drains.

Certificate of Merit, 1890.

To T. J. Moss Flower.



Description.—A machine for Testing Drains by smoke. The nozzle at the end of the flexible hose attached to the machine is inserted into a gully or opening in the Drain. Lighted sulphur or smoke paper is placed in the Combustion Chamber. By turning the handle, which is connected with a revolving fan, the smoke is discharged into the drain.

Sizes.—$1\frac{1}{4}$ in. and $1\frac{1}{2}$ in. pipe.

Prices.—From £2 15s. to £4 10s.

Manufactured by J. Watts & Co., Broad Weir Works, Bristol.

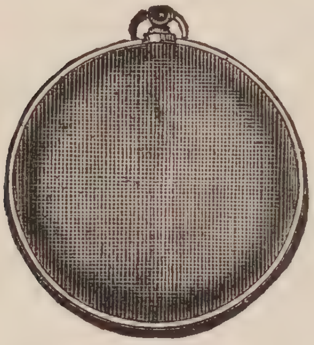
CLASS III.—HEATING, LIGHTING, AND VENTILATING.

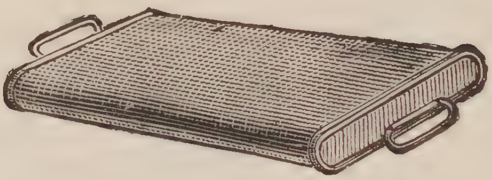
DIVISION C.—CLASS III.—Section 1. Heating Apparatus.

Chemical Heat Retainers.

Certificates of Merit, 1889 and 1890.

To PETERS, BARTSCH & Co.





DESCRIPTION.—These Warmers are hermetically sealed; they contain a Chemical Substance which possesses the property of giving out an equable heat from 4 to 16 hours, according to size. The Warmers have to be put into boiling water, and left in it until the chemicals inside are perfectly liquid, which can be ascertained by shaking the warmer.

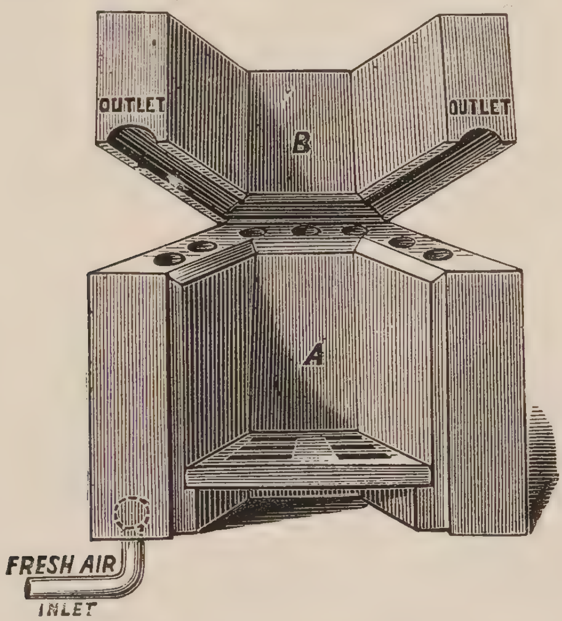
PRICES.—From 17s. 6d. to £1 16s.

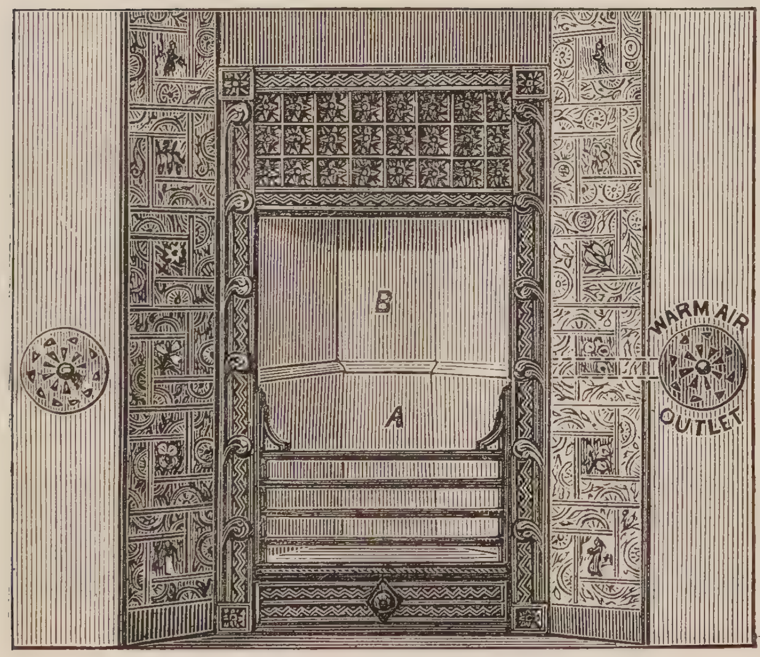
Manufactured by PETERS, BARTSCH & Co., Derby.

Lloyd's Winchester Grate.

Certificate of Merit, 1889.

TO THE WORCESTER SANITARY AND VENTILATING CO.





DESCRIPTION.—The body of the Stove is manufactured in fire-clay; and having a series of tubes moulded in the fire-clay, which are supplied with fresh air from the outside, throws an amount of warmed air into the apartment. The warmed air admitted is passed into the apartment through vertical tubes in the body of the Grate. The only metal employed in the construction is in the front and bars, the bottom being moulded in fire-clay.

SIZES.—14 in.	16 in.	18 in.	20 in. fires.	
PRICES.—16/-	18/-	20/- each.		

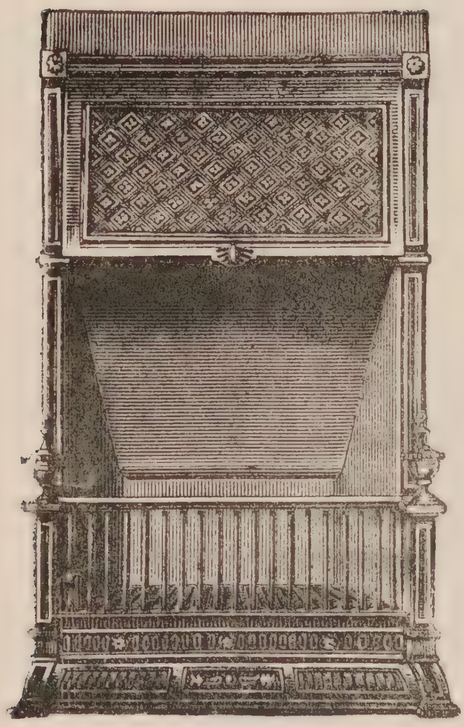
Manufactured by T. LLOYD & SONS, Winchester.

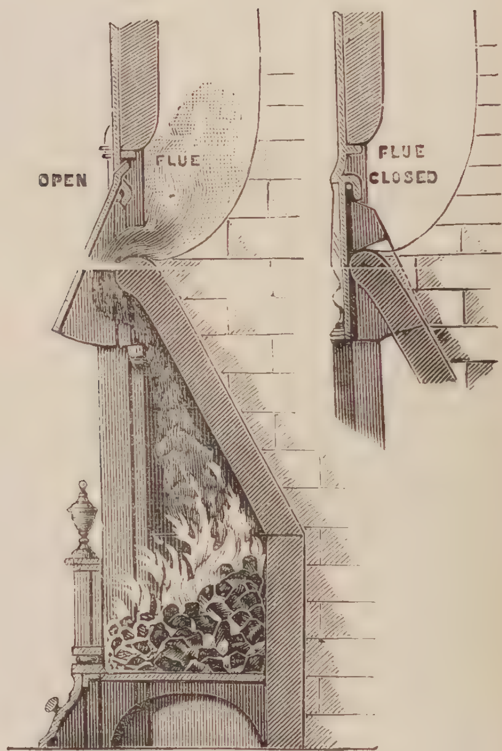
DIVISION C.—Class III.—**Section 1.** *(Continued.)*

Marlborough Grate.

Certificate of Merit, 1889.

To J. Ward & Sons.





Description.—In the construction of this Grate the brick back constitutes a heating surface, and is made to project over the fire to deflect the heat. The projecting canopy is removable and adjustable, so as to give access to the chimney for building up the back of the fire, and for sweeping the chimney.

Sizes.—Made with 12 in., 15 in., 18 in., 21 in., or 24 in. fires.

Prices.—From £1 17s. 6d.

Manufactured by Steel & Garland, Wharncliffe Works, Sheffield; Show Rooms, 18, Charterhouse Street, Holborn Circus, London, E.C.

DIVISION C.—CLASS III.—Section 1. *(Continued.)*

Eagle Grate.

Certificate of Merit, 1890.

To THE EAGLE RANGE AND FOUNDRY CO.

DESCRIPTION.—By means of Regulating Doors in front the fire can be made to burn fast or slow, and it can be used as an open fire or a closed stove.

SIZES.—In all sizes to fit existing or new Mantelpieces.

PRICES.—From £5 to £20 in Black, Bronze, and Brass.

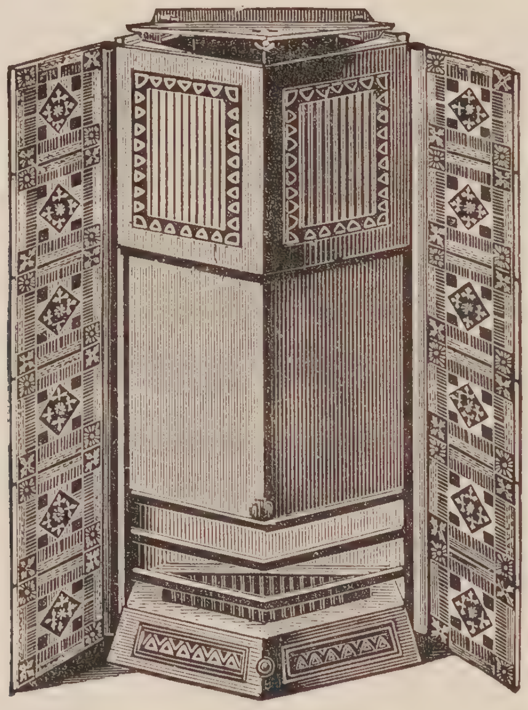
Manufactured by THE EAGLE RANGE AND FOUNDRY CO., 176, Regent Street, W.

DIVISION C.—CLASS III.—Section 1. *(Continued.)*

No. 35 Eagle Regulator, for Regulating Draught to Eagle Open Firegrate.

Certificate of Merit, 1892.

To EAGLE RANGE AND FOUNDRY CO.



DESCRIPTION.—When the regulating shutter is raised at its highest it becomes a slow combustion Grate. When it is desired to increase the speed of combustion the shutter is lowered as much as may be found necessary; or in lighting the fire it can be lowered until it rests on the front fire bars, as in the illustration. The shutter can be fixed at any position required.

Manufactured by EAGLE RANGE AND FOUNDRY CO., 176, Regent Street, and 58, St. Paul's Churchyard, London; 2, St. Augustens Parade, Bristol; Works, Catherine Street, Aston, Birmingham.

DIVISION C.—Class III.—**Section 1.** *(Continued.)*

Decorative Glazed Faience Fire-places.

Medal, 1890.

To Burmantoft's Works, The Leeds Fireclay Co.

Sizes.—Width of Grates, 15 in., 18 in., 21 in., and 24 in.

Manufactured at Burmantoft's Works, The Leeds Fireclay Co., Limited.

Stoves, Mantelpieces, and Brass-work.

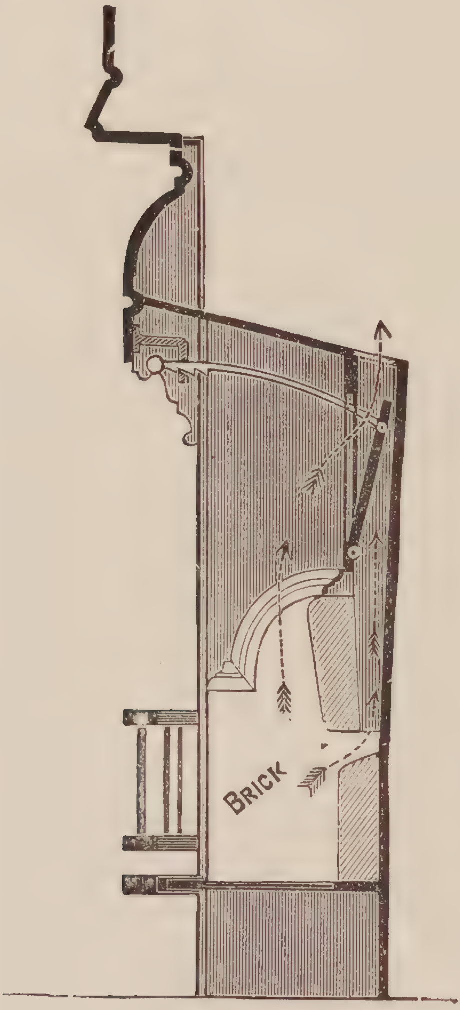
Certificate of Merit, 1890.

To C. G. Reed & Son, 26, North Street, Brighton.

Jackson's Grates for Burning Anthracite Coal.

Medal, 1892.

To E. A. CLEEVES & Co.



SECTION THRO' CENTRE.

DESCRIPTION.—This Grate is designed for burning anthracite coal. By an arrangement of the flue, the position of a damper (moved easily from the front of the Grate) regulates the draught so that, whether fast or slow burning fuel is used, the fire may be made great or small. The economical advantages claimed for this Grate apply to any sort of coal which may be burned in it; but it is specially adapted for burning anthracite coal.

PRICES.—16 in. fire, 34 in. wide, £3 11s. 6d.; 18 in. fire, 36 in. wide, £3 16s. 6d.

Manufactured by E. A. CLEEVES & Co., 3, Mileage Wharf, Westbourne Park Road, W.

DIVISION C.—CLASS III.—**Section 1.** *(Continued.)*

Open Gas Fire.

Certificate of Merit, 1890.

TO CHARLES WILSON & SONS.

DESCRIPTION.—Metal Gratings of peculiar construction are placed between the bars in front and a Corrugated Fire-Brick Slab at the back of the fire. The iron bars are raised to a glowing heat by a series of Bunsen flames, and the heat reflected into the room by a Fire-Brick Slab. The fire can also be fitted on the hearth in front of the bars of a grate, on the tops of the bars, inside the grating, or on the Stands or Pedestals. The Burners are of an atmospheric type.

SIZES.—11 in. wide, 15 in. high; 13 in. wide, 15 in. high; 15½ in. wide, 15 in. high; 19 in. wide, 16 in. high.

PRICES.—£1 1s., £1 5s., £1 10s., £2.

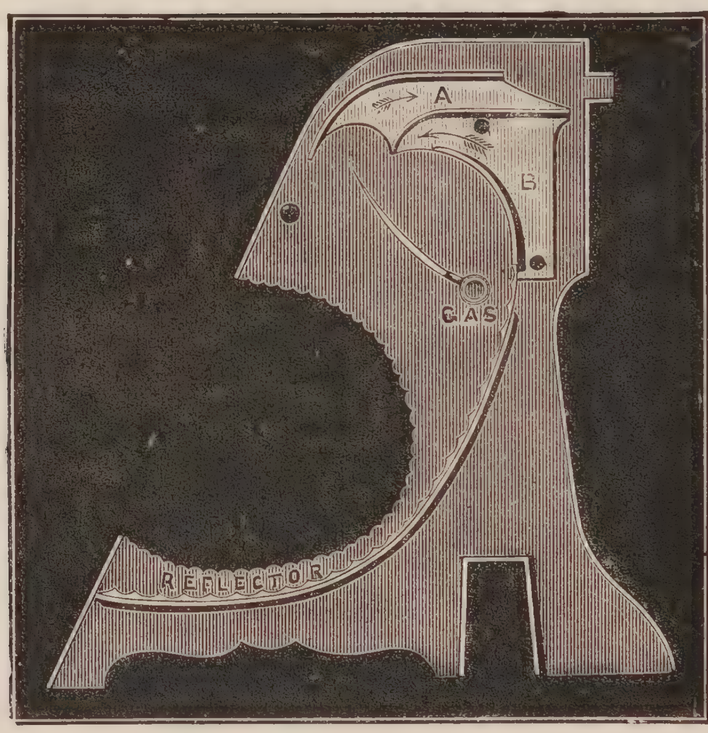
Manufactured by CHARLES WILSON & SONS, 76, Queen Street, Cheapside, E.C., and Carlton Works, Leeds.

DIVISION C.—CLASS III.—Section 1. *(Continued.)*

Marsh-Greenall Regenerating Gas Heating Stove.

Certificate of Merit, 1890.

To GREENALL & Co.



Sectional View of "M.G. 2" Size.

DESCRIPTION.—Iron Plates with 24 Gills **A** are fixed across the Stove as shown. The Gas pipe has three ordinary Bray's No. 4 Burners in it. The products of combustion from the flames pass up the 24 Flues **A**, heating the Gills red hot. The air entering at the back of the Stove to feed the flames is heated as it ascends the 24 Passages **B**. The Burners are of the luminous type.

SIZES.—"MG 2," "MG 3," "MG 4," "MG 6," and "Clarence."

PRICES.—£1 10s., £1 17s., £1 13s., £2 5s., £5 8s., and £8 8s.

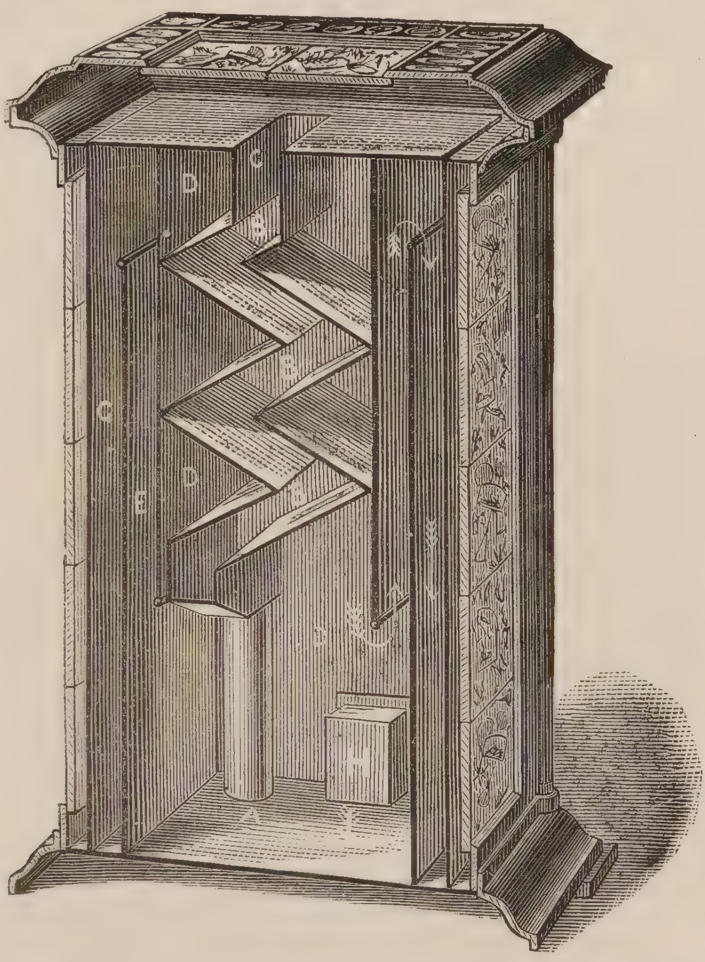
Manufactured by GREENALL & Co., Gas Engineers, 120, Portland Street, Manchester.

DIVISION C.—CLASS III.—Section 1. *(Continued.)*

Thermo Hygienic Gas Stove.

Certificate of Merit, 1892.

To DAVIS GAS STOVE CO.



DESCRIPTION.—The interior is designed so that the greatest amount of heat may be extracted from a given quantity of gas before the products of combustion are allowed to escape to the outer air. The fresh air is drawn through the fresh air inlet A, and warmed in its passage by passing into the heating chamber B (surrounded by the chamber D). The warmed fresh air rising in the room from the outlet C causes a large proportion of the air vitiated by breathing to descend, and is then drawn in by the burner in front of A, and carried off by means of the chamber D to the ascending flue E and descending flue G to the burnt air outlet H, from which it is carried outside the building. Fitted with an arrangement so that the gas cannot be turned on before the burner is drawn out for lighting.

SIZES.—Outside measurements, 2 ft. 5 in. high, 1 ft. 7 in. wide, 1 ft. 3½ in. deep. 2 ft. 10½ in. high, 1 ft. 10 in. wide, 1 ft. 5½ in. deep. 3 ft. 3½ in. high, 2 ft. 0½ in. wide, 1ft. 6½ in. deep.

PRICES.—£4 16s., £6 15s., £8 15s. 6d.

Manufactured by THE DAVIS GAS STOVE CO., LIMITED, Camberwell, S.E.

Gas Kettle.

Certificate of Merit, 1890.

To CHARLES WILSON & SONS.

DESCRIPTION.—This is a strong Copper Kettle, placed within a Cast Iron Case, which is attached to a powerful atmospheric Gas Burner by a hinge.

SIZES.—1 Gallon and 2 Gallons.

PRICES.—15s. £1 5s.

Manufactured by CHARLES WILSON & SONS, 76, Queen Street, Cheapside, E.C., and Carlton Works, Leeds.

DIVISION C.—CLASS III.—**Section 1.** *(Continued.)*

Cyclone Geyser.

Certificate of Merit, 1892.

To T. BAILEY, JUNR.

SIZES.—Various.

PRICES.—According to size.

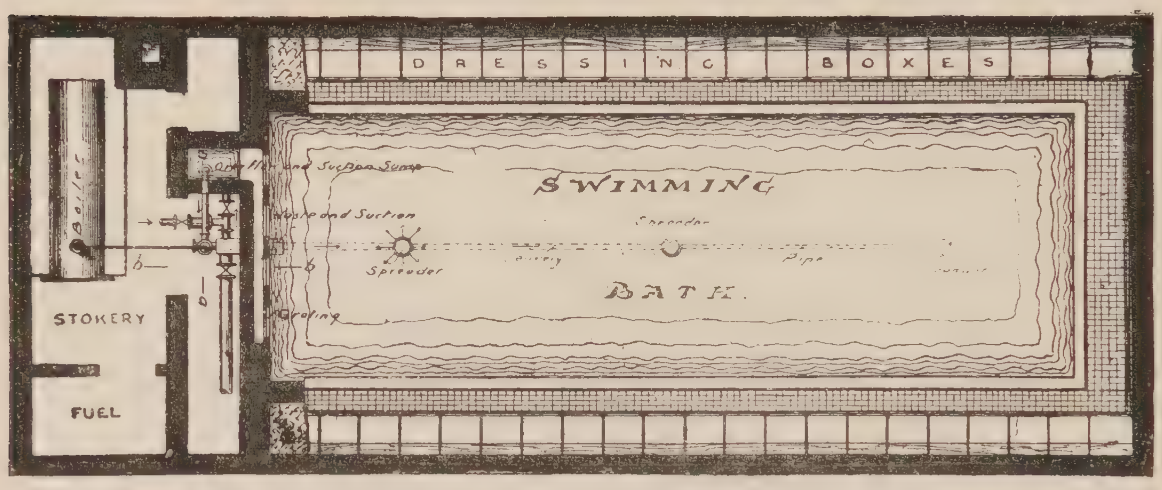
Manufactured by T. BAILEY, JUNR., 65, Commercial Road, Landport, Portsmouth.

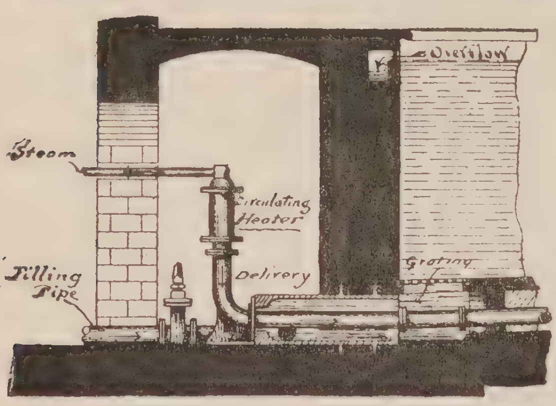
DIVISION C.—Class III.—**Section 1.** *(Continued.)*

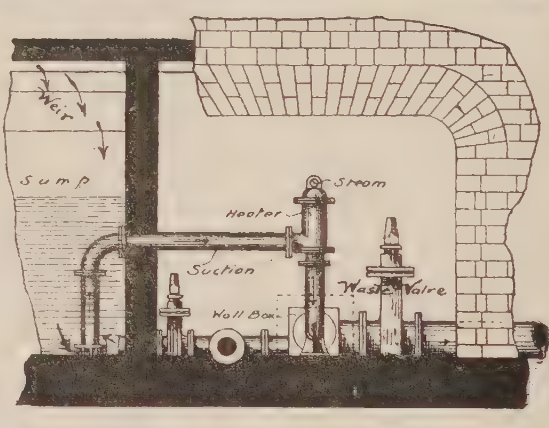
Rosher System of Heating and Circulating Water in Baths.

Medal, 1890.

To Rainbow Engineering Co.







Description.—The System consists of a *forced circulation* of the water by means of a "circulating heater" (or a pump in combination with a heater). The water is drawn from the Bath at suitable points and redelivered through "spreaders" placed flush with the Bath floor. While filling the Bath the water is drawn from the bottom; when filled, the upper stratum of water is made to pass out over a "weir overflow," and is then returned to the Bath (by the action of the heater or pump as the case may be) *viâ* the spreaders. In some cases a specially constructed aërating filter is interposed between the overflow and the pump which returns the water to the Bath.

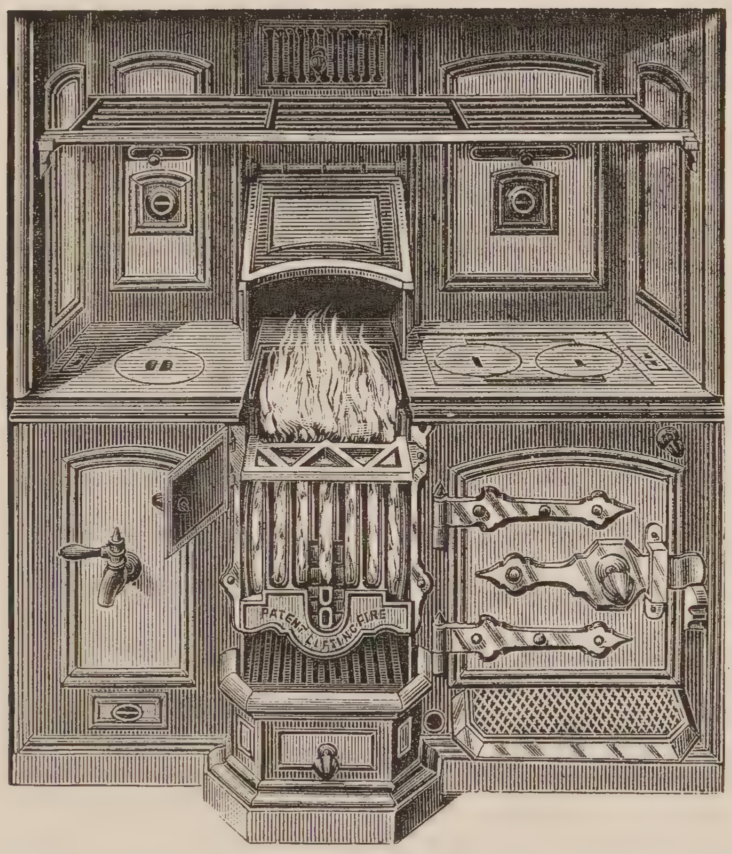
Schemes and estimates furnished on application.

Manufactured by The Rainbow Engineering Co., 39, Victoria Street, S.W.

Herald Kitchen Range.

Certificate of Merit, 1889.

To J. WARD & SONS.



DESCRIPTION.—It is Constructed with an Improved Lifting Bottom Grating which works upon two Projecting Studs *underneath* the Grate. The fire is shallow from back to front, and the Range is made with combined open and close fire. The Hot Plates over the fire are made to slide back. There is also a Cinder Sifter under the fire.

SIZE.—4 ft.

PRICE.—£16 5s. 6d.

Manufactured by R. RUSSELL & SONS, Peel Foundry, Derby.

Badger's Kitchener.

Certificate of Merit, 1889.

To WORCESTER SANITARY AND VENTILATING CO.

DESCRIPTION.—Can be converted into an open or closed Stove.

SIZES.—3 ft. to 7 ft.

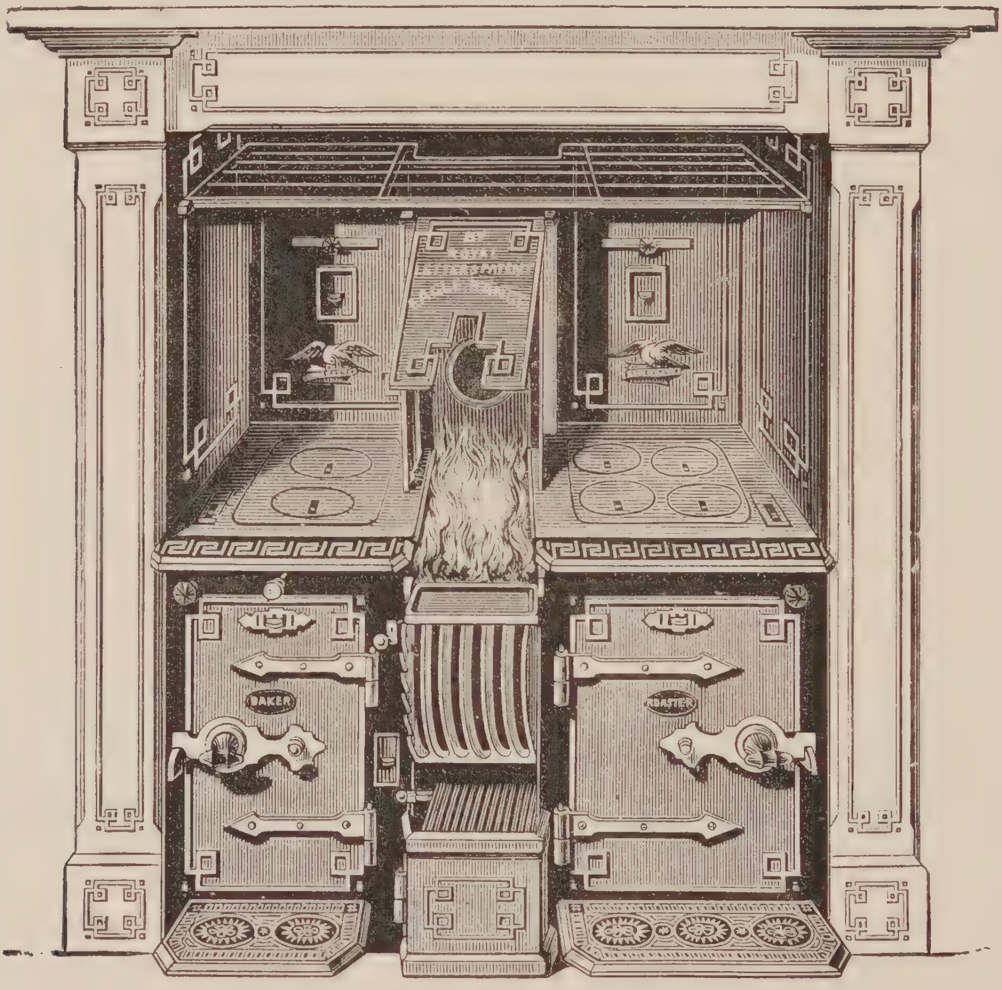
PRICES.—£7 to £18.

DIVISION C.—CLASS III.—**Section 2.** *(Continued.)*

Improvements in Eagle Ranges.

Certificate of Merit, 1890.

To THE EAGLE RANGE AND FOUNDRY CO.



DESCRIPTION.—The size of the fire can be increased or diminished as required. It can be used as an open range, as shown in the sketch, or made into a close stove by closing the hot plate over the fire, and closing the doors of the smoke hood at the back.

SIZES.—In sizes from 2 ft. upwards.

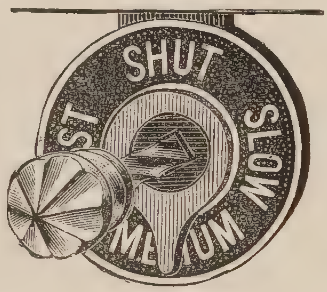
PRICES.—From £4 10s. to £150.

Manufactured by THE EAGLE RANGE CO., 176, Regent Street, W.

Indicating Damper to Eagle Range.

Certificate of Merit, 1892.

TO EAGLE RANGE AND FOUNDRY CO.



DESCRIPTION.—This shows on the front of the Range exactly at what draught the Range is working by indicating the position of the damper.

PRICE.—6s. 6d. per damper.

Manufactured by EAGLE RANGE AND FOUNDRY CO., 176, Regent Street, and 58, St. Paul's Churchyard, London; 2, St. Augustens Parade, Bristol; Works, Catherine Street, Aston, Birmingham.

Grecian Kitchen Range.

Certificate of Merit, 1892.

TO PARKHOUSE IRON CO.

DESCRIPTION.—Fitted with two doors and canopy, open and close fire, large oven on left hand, coves, and best plate-rack. Hole $\frac{5}{8}$ in. thick. Long damper. Rods and knobs, ashpit lining. Back boiler flue, cinder sifter to ashpan, cone ventilators, bright edge to roof-plate, sliding fire cover, round loose fire bars.

SIZE.—42 in. × 26 in. × 56 in.

PRICE.—

Manufactured by PARKHOUSE IRON CO., Falkirk, N.B.

DIVISION C.—CLASS III.—Section 2. *(Continued.)*

Dow's Kitchen Range.

Certificate of Merit, 1892.

To PARKHOUSE IRON CO.

DESCRIPTION.—Double oven reversing flue to large oven. Hobs $\frac{3}{4}$ in. thick, coves and polished plate-rack. Bright moulding on front of roof-plate and edges of coving. Two cone ventilators, ashpit linings, ashpan with cinder sifter, patent back boiler flue, dampers with rods and knobs, heavy fire cover, cups and rings, round loose bars, hobs ground, and range Berlin blacked.

SIZE.—60 in. × 30 in. × 60 in.

PRICE.—

Manufactured by PARKHOUSE IRON CO., Falkirk, N.B.

Dublin Kitchen Range.

Certificate of Merit, 1892.

To PARKHOUSE IRON CO.

DESCRIPTION.—Fitted with two doors and canopy, open and close fire arrangement, double oven or large oven with revolving flue, covings with brown and white tiles, having polished plate-rack. "Eagle" fire, with polished front and heavy fall-bar (bottom fitted to drop ashes through), ashpit with linings, and cinder sifter to ashpan. Heavy fire cover with cups and rings. Heavy hobs, roof-plate with two cone ventilators. Dampers with long rods and knobs, sliding fire cover, patent back boiler flue.

SIZE.—54 in. × 30 in. × 60 in.

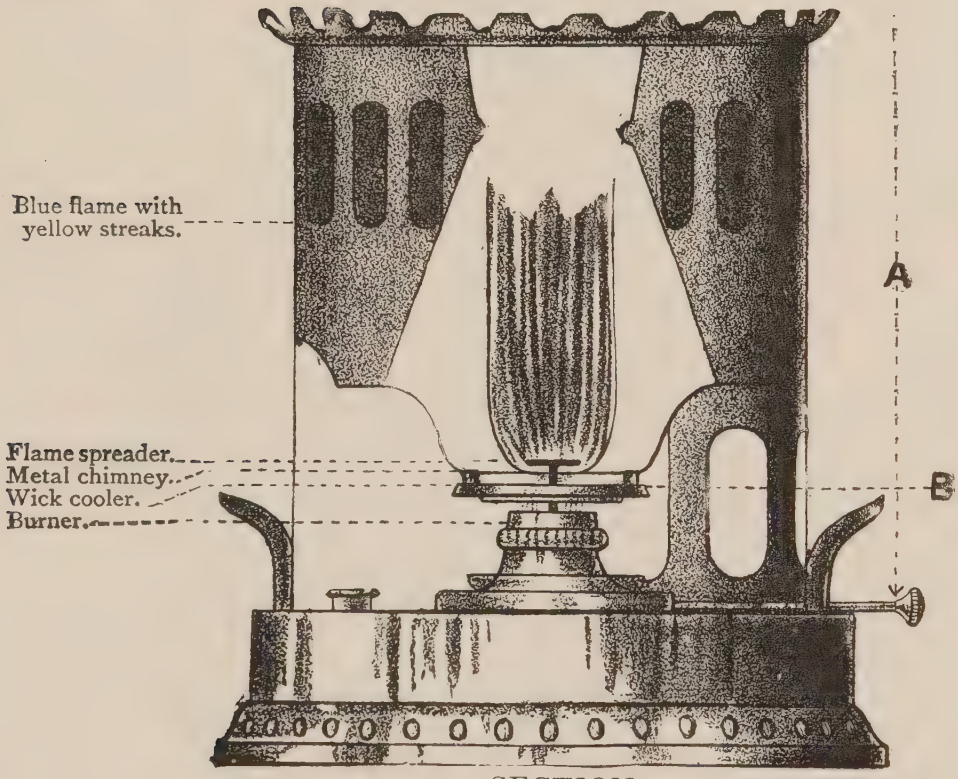
Manufactured by PARKHOUSE IRON CO., Falkirk, N.B.

DIVISION C.—CLASS III.—**Section 2.** *(Continued.)*

Defries Petroleum Cooking Stove.

Certificate of Merit, 1889.

To G. HARRISON.



SECTION.
Shewing flame at full power.

DESCRIPTION.—The object is to burn air with gas generated from oil, so as to produce a blue flame without throwing off smoke or smell. The wick is surrounded with a ring of peculiar construction, that causes a large volume of air to be drawn over the wick, thus preventing the outer surface of the wick from getting alight; the outer surface thus gives off gas which is burned on the top of the wick in combination with the air that has passed over the wick.

SIZE.—Height, 11 in.

PRICES.—From 17s.

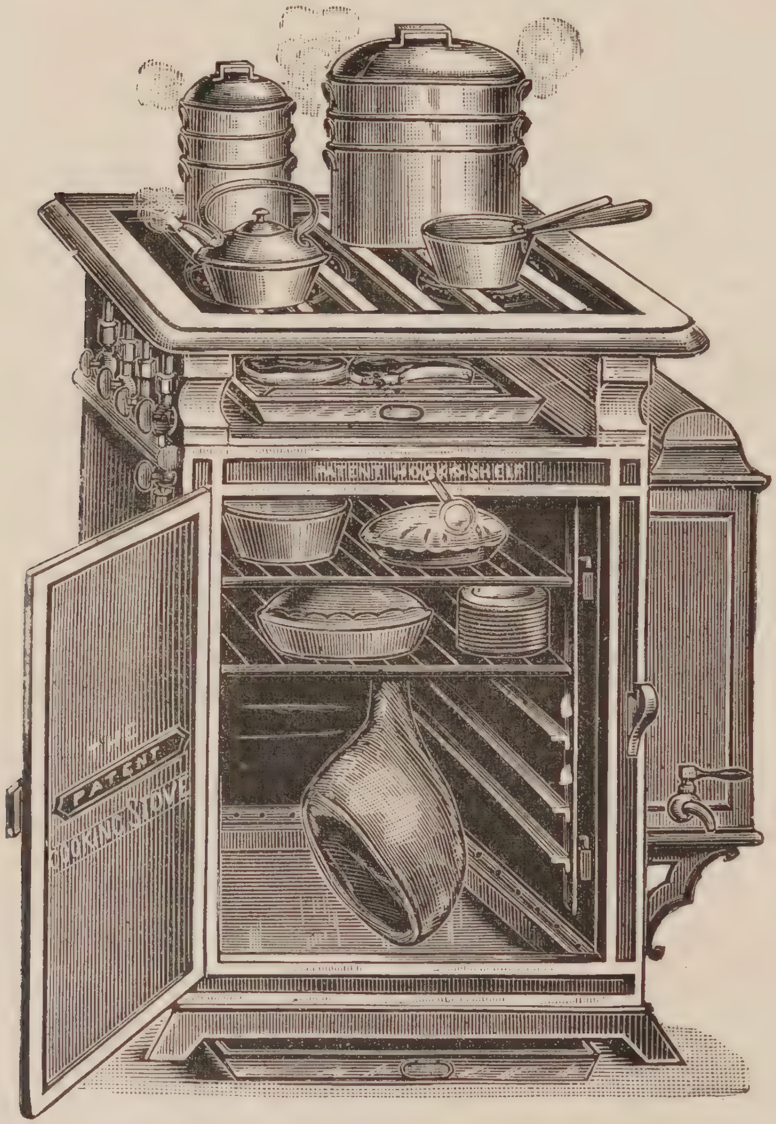
Manufactured by THE METROPOLITAN LIGHT COMPANY, 43, Holborn Viaduct, E.C.

DIVISION C.—CLASS III.—**Section 2.** *(Continued.)*

The "Beacon" Gas Cooker.

Medal, 1890.

To FREEMAN, EMERY & CO.



DESCRIPTION.—Enamelled inside and outside, Wrought or Cast Iron. Double-cased and jacketted with the Patent Non-Conductor. The Shelves are made to draw out the full depth of the Oven without tilting or falling. New Rise and Fall Grilling Burners for Broiling Chops and Steaks, Toasting Bread, Boiling Kettles, &c., fitted to all these Stoves. The Burners are of the atmospheric type.

SIZES.—High:	27,	30,	34,	35,	37,	38 in.
Wide:	15,	20,	22,	26,	28,	30 in.
Deep:	15,	19,	20,	23,	24,	26 in.
PRICES.—	£2 5s.,	£3 10s.,	£5 10s.,	£6 10s.,	£8 10s.,	£10 10s.

Manufactured by FREEMAN, EMERY & CO., Birmingham.

DIVISION C.—CLASS III.—Section 2. *(Continued.)*

Artizan Gas Cooker.

Certificate of Merit, 1890.

To FREEMAN, EMERY & Co.

DESCRIPTION.—This Artizan Stove is the Beacon Stove in a cheaper make, being made of lighter material and single cased. The Burners are of the atmospheric type. See page 84.

SIZE.—28 × 18 × 16 in.

PRICE.—£2 10s.

Manufactured by FREEMAN, EMERY & Co., Birmingham.

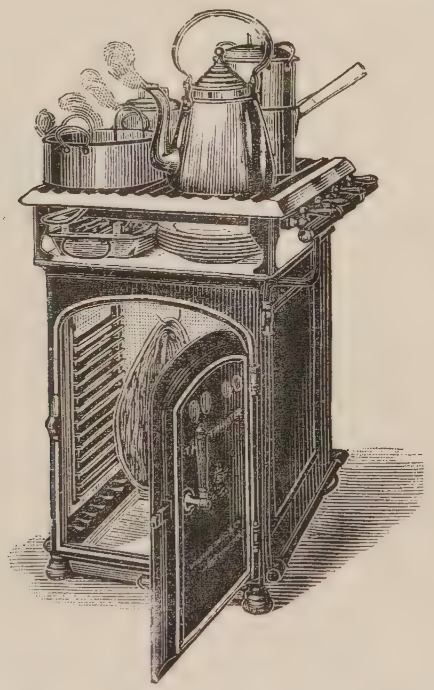
Westminster Gas Cooker.

Certificate of Merit, 1890.

Westminster Gas Cooking Stove, with Bunsen Burner.

Certificate of Merit, 1892.

To W. SUGG & Co.



DESCRIPTION.—The Oven is ventilated, and lined with Special Double Enamelled Iron Plates. The top of the Oven, under the Hot-plate, is fitted with Sugg's Enamelled Ribbed Top-plate; this also is specially enamelled pure White. These Kitcheners can, therefore, always be cleaned immediately after use, and an offensive accumulation of grease and dirt is consequently prevented. The Burners in the Oven are of the luminous type, and those of the Hot-plate are atmospheric.

SIZES.—High—31 in., 34 in., 35 in. Wide—20 in., 22 in., 24 in. Deep—18 in., 21 in., 22 in.

PRICES.—£5 14s., £6 15s., £7 17s. 6d.

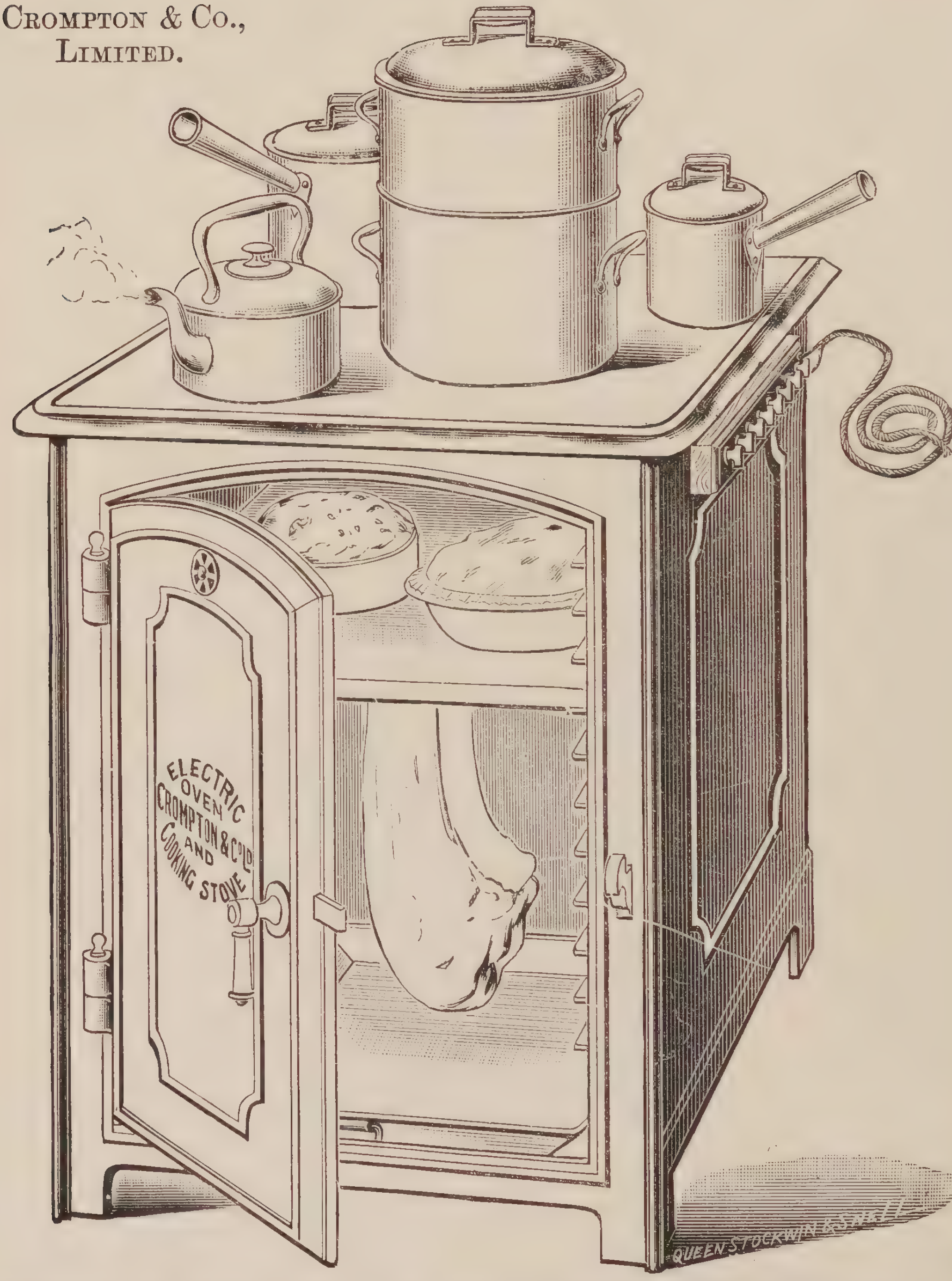
Manufactured by WILLIAM SUGG & Co., Vincent Works, Westminster.

DIVISION C.—CLASS III.—Section 2. *(Continued.)*

Apparatus for Cooking by Electricity.

Medal, 1892.

To CROMPTON & CO., LIMITED.



DESCRIPTION.—The Electric Oven is one of the applications of the use of Electric Cooking Apparatus. As no combustion takes place, the oven is enclosed with the exception of a small opening for ventilation. The inside plates of the oven are heated by electricity and made radiating surfaces, and can be turned on or off at will. When once the oven is heated to the required degree, nearly the whole of the current may be turned off, owing to the fact that a very small amount only is required to make up for loss by radiation. The heated air cannot escape, there being no chimney. To heat up the oven in the first instance with all the switches on, the cost may be more than gas, but after the first fifteen or twenty minutes, when the desired heat is attained, the cost of maintaining the oven at this heat is very small. The food is cooked in an absolutely pure atmosphere. The principle is also applied to kettles, hot plates, and grills.

PRICE.—From £7 10s.

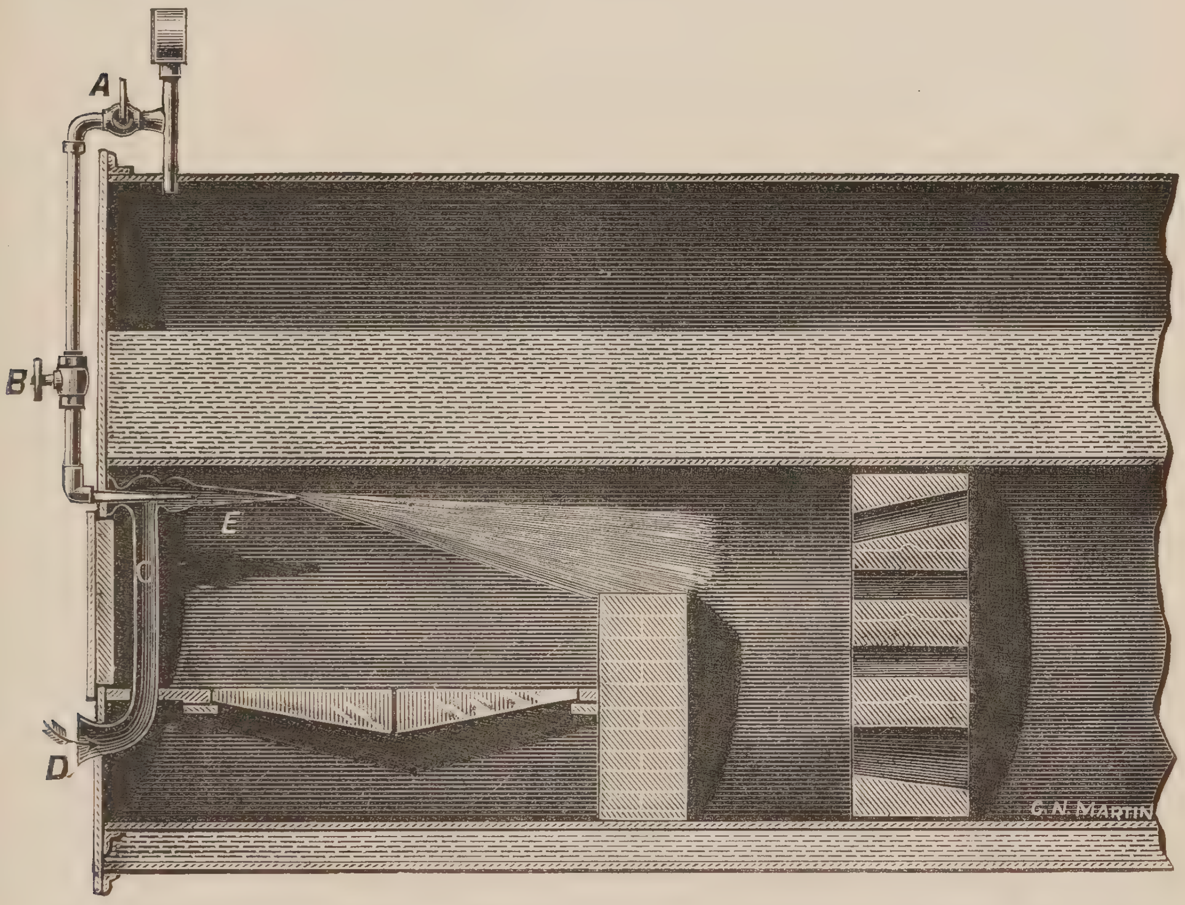
Manufactured by CROMPTON & CO., LIMITED, Show Rooms, 148, Brompton Road, S.W.

DIVISION C.—CLASS III.—Section 3. Smoke Preventing Appliances.

"Invicta" Smoke-Consumer and Fuel Economizer.

Certificate of Merit, 1890.

To THE IMPERIAL SMOKE-CONSUMER CO.



DESCRIPTION.—The Apparatus consists of a Hot-air Injector, E, fitted inside the Furnace. Air is conducted to the body of the Injector by a series of Curved Pipes, C, inside the Furnace, having their Orifices or Inlets, D, below the Dead-Plate and turned outwards. The air is injected over the Furnace by the aid of a small jet of steam which, mixing with the heated air in the body of the Injector, is discharged into the Furnace above the fire-grate, and in the directon of the Bridge, in a dry state.

SIZE.—It can be adapted to any Furnace.

PRICES.—"Invicta" Hot-air Injector, without Bridge, £8; with Barnes' Sectional Bridge, complete, £12.

Manufactured by THE IMPERIAL SMOKE-CONSUMER CO., 69, Falmouth Road, S.E.

Boiler-Covering Bricks.

Certificate of Merit, 1890.

To THE IMPERIAL SMOKE-CONSUMER CO.

DESCRIPTION.—These Bricks are made with Special Studs so as to form a Hot-Air Chamber over the Boiler. In case of leakage in the Boiler or accident, the Covering can be taken off and replaced without deterioration.

SIZES.—The Bricks are 9 in. × $4\frac{1}{2}$ in. × $2\frac{1}{2}$ in. thick.

PRICES.—3d. each, or 10d. per Super Foot.

Manufactured for THE IMPERIAL SMOKE-CONSUMER CO., 69, Falmouth Road, S.E.

Barnes' Sectional Bridge for Boilers.

Certificate of Merit, 1890.

To THE IMPERIAL SMOKE-CONSUMER CO.

DESCRIPTION.—It consists of a series of specially prepared Sections of Fire-Clay, arranged to interlock each other. The Sections or Blocks are so constructed that the hot gases are prevented from being carried too rapidly away, and the Blocks absorbing or retaining the heat impart the same to the surrounding Boiler-Tube, whilst the formation of the orifices in the Sections direct the passing gases and flames to traverse the walls or sides of the Tube.

SIZES.—For Boilers, Tubes, 2 ft. 4in. up to 3 ft. diameter.

PRICES.—£6.

Manufactured for THE IMPERIAL SMOKE-CONSUMER CO., 69, Falmouth Road, S.E.

Improved Fire Bars and Bridge.

Certificate of Merit, 1890.

To J. SMEATON, SON & CO.

DIVISION C.—CLASS III.—**Section 4. Lighting, including Electric Lighting.**

"Cromartie" Library Lamp.

Medal, 1890.

To William Sugg & Co.

"Tanjore" Pattern.

Description.—Suitable for use as a Library Reading Lamp, &c. Can be readily fitted to any pillar, bracket, or pendant. Each Lamp is fitted with a Patent Automatic Governor, for the purpose of correcting any variation of pressure. The Lamp is made in a variety of forms, ventilating and non-ventilating, suited to different requrements. The "Tanjore," shown above, has a Nickelled Body and 10½ in. Albatrine Shade.

Sizes and Prices of "Tanjore" Lamp.—

3 cubic feet (16 candle gas) per hour,	£1 10s. 0d.
4 " " "	£1 16s. 6d.

Manufactured by William Sugg & Co., Vincent Works, Westminster.

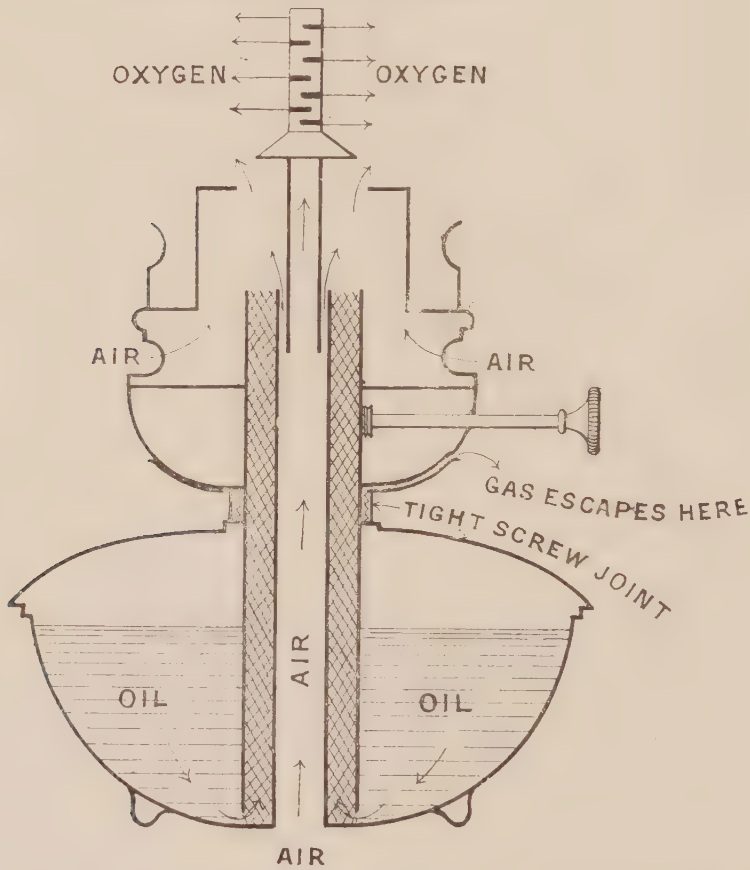
DIVISION C.—CLASS III.—**Section 4.** *(Continued.)*

Defries Safety Lamp.

Medal, 1889.

To G. HARRISON.

SECTION OF OIL FOUNT



DESCRIPTION.—It consists of an inner tube fixed to the reservoir over which the cotton goes, and to the burner is fixed another tube which goes down over the wick to within one-eighth of an inch of the bottom of the reservoir. Air is admitted into the reservoir from a groove placed outside the burner. The result obtained is that no vapour from the oil can come in contact with the flame. No oil is spilt if the lamp be overturned.

PRICES.—From 1s. 6d. to £9 5s.

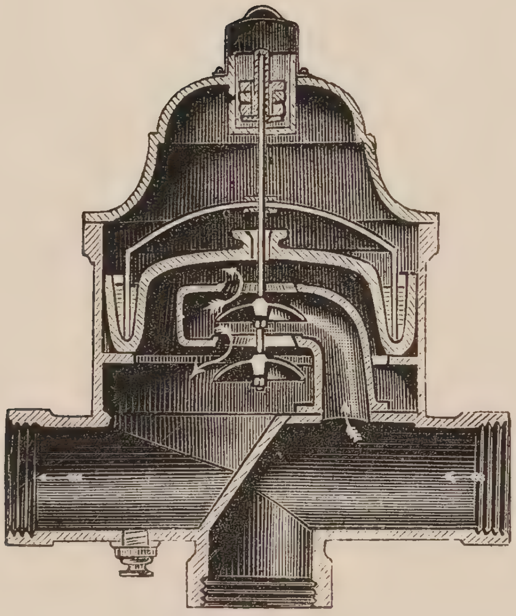
Manufactured by THE METROPOLITAN LIGHT Co., 43, Holborn Viaduct, E.C.

DIVISION C.—CLASS III.—**Section 4.** *(Continued.)*

Mercury Gas Governor.

Medal, 1890.

To JAMES STOTT & Co.



DESCRIPTION.—An inverted Metal Cup, sealed in an annular trough filled with mercury. To the centre of the Cup a spindle is fixed, carrying at its lower end a Double Valve. Increased pressure from the main or fewer lights raises the Cup and partially closes the Valve. Diminished pressure or more lights open the Valve, which is regulated by weights on the upper end of the spindle.

SIZES.—From ½ in. to 8 in., controlling 10 to 5,000 lights.

PRICES.—From £1 19s. (½-in.) to £17 11s. 6d. (4 in.).

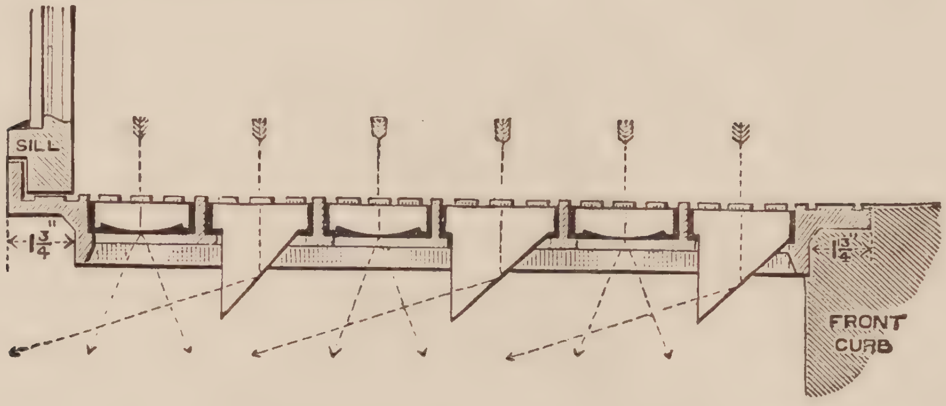
Manufactured by JAMES STOTT & Co., Fleet Street, London, E.C.; and Vernon Works, Oldham.

DIVISION C.—CLASS III.—**Section 4.** *(Continued.)*

Semi-Prism Reflecting Pavement and Roadway Lights.

Medal, 1890.

To HAYWARD BROS. & ECKSTEIN.



DESCRIPTION.—The Reflecting Prisms throw the daylight in the direction indicated by the arrows, and distribute it over the back portion of the apartment, while the Convex Lenses diffuse the light.

Manufactured by HAYWARD BROS. & ECKSTEIN, 187, Union Street, Borough, S.E.

Exhibit of Electric Lighting.

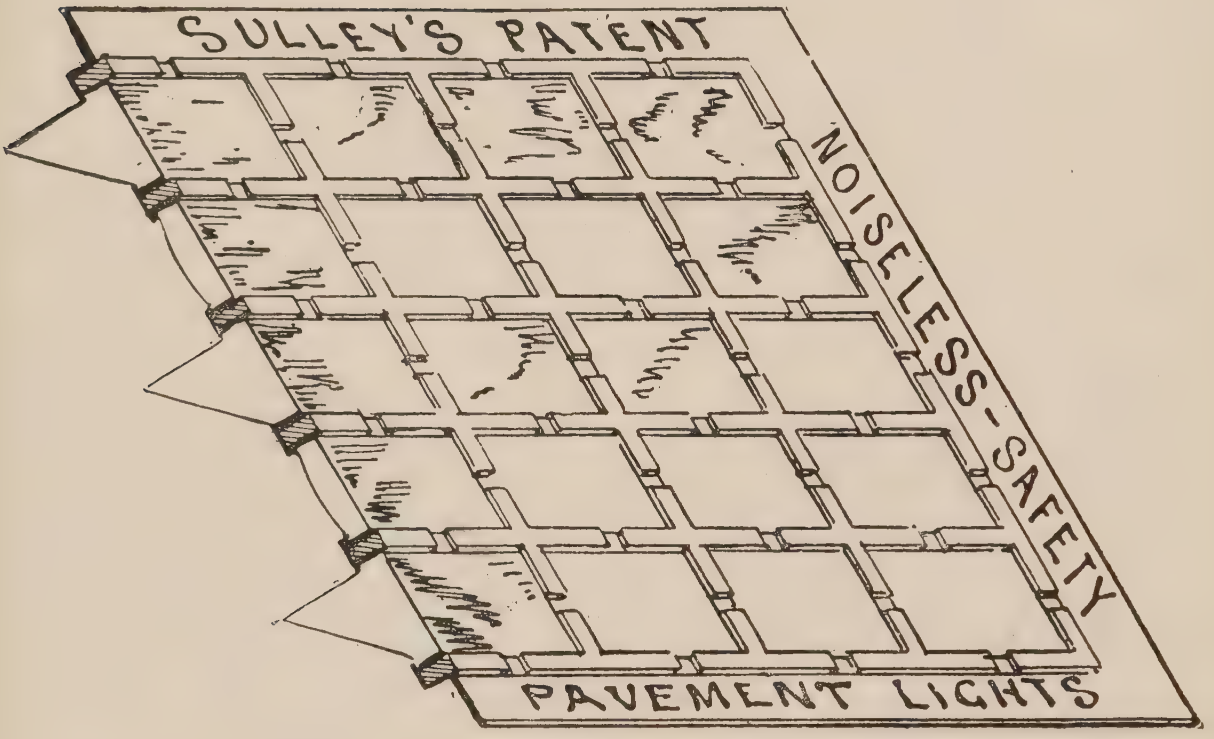
Medal, 1890.

To C. G. REED & SON, 26, North Street, Brighton.

Noiseless Safety Pavement.

Certificate of Merit, 1892.

To H. SULLEY.



DESCRIPTION.—Pieces of wood are inserted in the iron framing between the squares of glass to prevent slipping.

PRICES.—From 7s. to 10s. per superficial foot.

Manufactured by H. SULLEY, 6, Albert Street, Nottingham.

Cainks' Automatic Gas Governor.

Medal, 1889.

To GUEST & CHRIMES.

DESCRIPTION.—This invention is to secure a means by which the pressure of gas in the mains issuing from the Gas Governor may be increased and diminished automatically, at such times and to such extent as the consumption of gas supplied therefrom requires, and thus prevent what frequently happens—an excess or deficiency of pressure, arising from the impossibility of the man in charge at the gas works being able always to anticipate the precise time and extent the pressure is required, consequent on the variation of the consumption which takes place in a town from time to time.

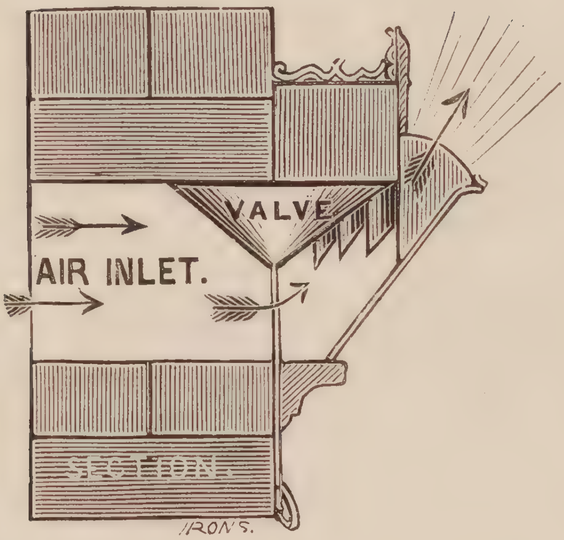
Manufactured by GUEST & CHRIMES, Rotherham.

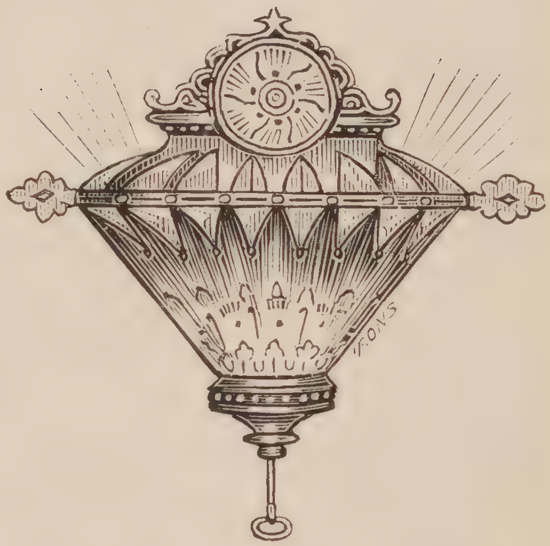
DIVISION C.—Class III.—**Section 6. Ventilators.**

Thomasson's Inlet Ventilator.

Certificate of Merit, 1889.

To W. Bennett & Co.





Description.—An Ornamental Semi-Circular Bracket with a number of openings separated by Gills or Divisions for diffusing the incoming air. The supply of air can be regulated by a Conical Valve which slides down behind the Division.

Price.—10s. and upwards.

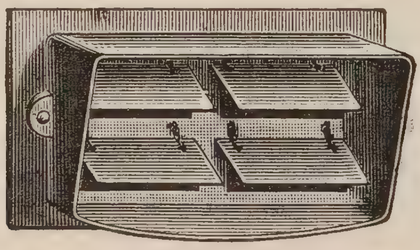
Supplied by W. Bennett & Co., Ironfounders and Patentees, 8, Nicholas Street, Worcester.

DIVISION C.—CLASS III.—Section 6. *(Continued.)*

Mica Flap Outlet Ventilator, with Hit-and-Miss Front.

Certificate of Merit, 1890.

To HAYWARD BROS. & ECKSTEIN.



DESCRIPTION.—For the discharge of heated and vitiated air from rooms into the smoke flue. The Valves are made of Mica, and open with the up current in the flue, but close against down draughts, and prevent smoke entering the room.

SIZES.—11 × 5 in.; 11 × 7 in.; 11 × 9 in.; 11 × 11 in.: 16 × 11 in.

PRICES.—	4/-	6/-	9/-	11/-	16/-

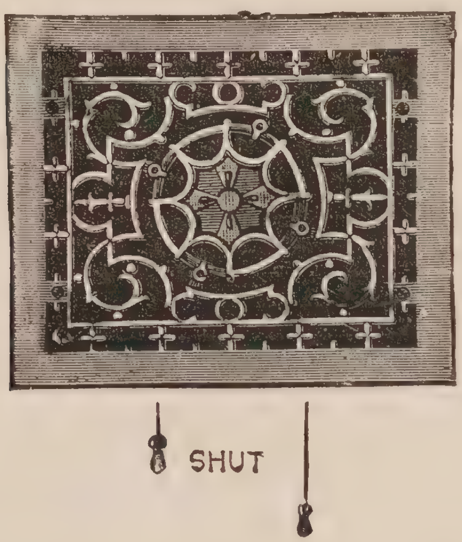
Manufactured by HAYWARD BROS. & ECKSTEIN, Union Street, Borough, London, S.E.

DIVISION C.—CLASS III.—**Section 6.** *(Continued.)*

Southwark Universal Venetian Ventilator.

Certificate of Merit, 1890.

TO HAYWARD BROS. & ECKSTEIN.



Outlet Section.

DESCRIPTION.—They act as "outlet" or "inlet," by reversing them when fixing. The Venetians can be set at any angle, and will remain in that position without the aid of a cleat hook.

SIZES.—	10 × 8 in.;	12 × 10 in.;	14 × 12 in.;	16 × 14 in.;	18 × 12 in.
PRICES.—	6/6	8/6	12/6	17/-	18/6

Manufactured by HAYWARD BROS. & ECKSTEIN, 187, 189, 191, and 193, Union Street, Borough, London, S.E.

DIVISION C.—Class III.—Section 6. *(Continued.)*

Ornamental Hit-and-Miss Air Bricks.

Certificate of Merit, 1890.

To Hayward Bros. & Eckstein.

Description.—Consists of an Iron Box, with pierced front, fitted with a sliding diaphragm behind.

Sizes.—9 in. × 3 in. to 18 in. × 9 in.

Prices.—From 1s. to 7s. each.

Manufactured by Hayward Bros. & Eckstein, 187, 189, 191, and 193, Union Street, Borough, London, S.E.

DIVISION C.—CLASS III.—Section 6. *(Continued.)*

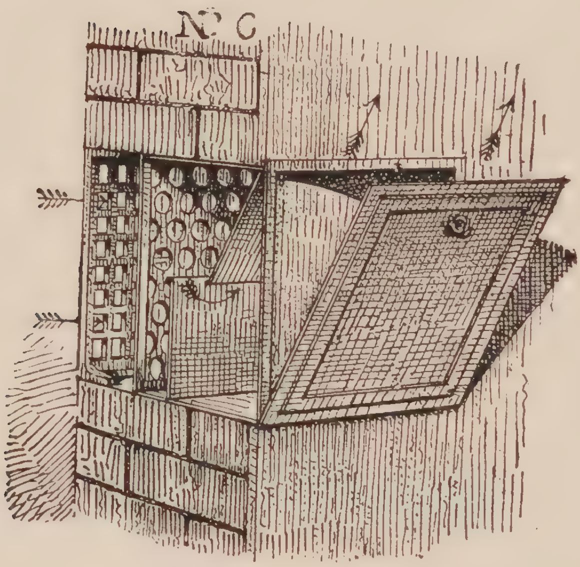
Wall Inlet Ventilator.

Certificate of Merit, 1890.

Improved Box Inlet Ventilator.

Certificate of Merit, 1892.

To C. KITE & Co.



DESCRIPTION.—Made of Sheet Iron, it is fixed in an opening in the wall, with an ordinary air grating on the outside. The Drawing represents the Ventilator open; the Spandrils or Cheeks are pressed closely to the sides by Springs to prevent leakage of air, and hold the movable front in any position open to closed; internally the Ventilators are fitted with Baffle-Plates, by which outside wind force is checked; the clear way through them is about half their external measurement.

SIZES.—6 in. × 9 in.; 8 in. × 6 in.; 10 in. × 6 in.

PRICES.—8s. 6d. and 10s. 6d.

Manufactured by C. KITE & Co., Christopher Works, Chalton Street, N.W

DIVISION C.—CLASS III.—**Section 6.** *(Continued.)*

Cast and Sheet-Iron Ventilating Gratings with Louvre Valves.

Certificate of Merit, 1890.

To H. HEIM.

Registered No., 147303.

DESCRIPTION.—This is bricked in the wall and acts as an outlet from a shaft rising from the heating chamber. It essentially consists of cast-iron frame with horizontal iron ledges, acting like a Venetian blind, and is opened and closed by means of a chain.

SIZES.—$8 \times 13\frac{1}{2}$ in.; $12\frac{3}{4} \times 18\frac{3}{4}$ in.

PRICES.—8s. 4d. 13s. 4d.

Manufactured by H. HEIM, 95 and 97, Oxford Street, W.

Round Ventilating Valves.

Certificate of Merit, 1890.

To H. HEIM.

DESCRIPTION.—An ornamental cast-iron frame, with two wing-flaps moved by key or fixed handle; or eight fan-shaped flaps moved by a spring, acted on by a handle in the centre in front.

SIZES.—$9\frac{3}{4}$ in. 12 in. 14 in. diameter.

PRICES.—5s. 6s. 8d. 8s. 6d.

Manufactured by H. HEIM, 95 and 97, Oxford Street, W.

DIVISION C.—CLASS III.—**Section 6.** *(Continued.)*

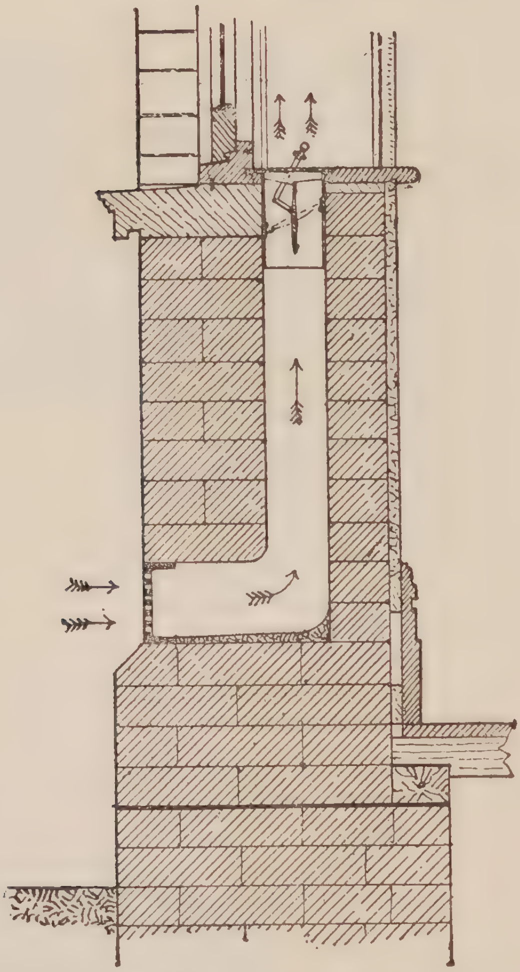
Lock Valve Inlet Ventilator.

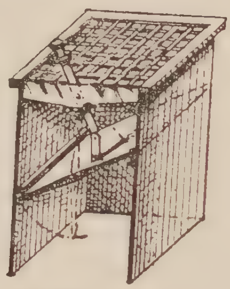
Certificate of Merit, 1892.

To C. KITE & Co., Chalton Street, N.W.

No 6H.

Window Sill Inlet.





Window Sill Inlet (closed)

DESCRIPTON.—Made to fit any openings, but specially suitable for window sills of Churches, Schools, &c. The drawing represents the Ventilator closed, the locking-lever pressing the valve tightly on its seating, thus preventing any leakage of air. To open same, the lever is pulled over, bringing the valve perpendicularly in the centre, thus giving a clear full way through the Ventilator.

PRICE AND SIZE.—From 13s. 6d.; 9 in. × 4½ in.

Manufactured by C. KITE & Co., Christopher Works, Charlton Street London, N.W.

DIVISION D.—PERSONAL AND DOMESTIC HYGIENE.

DIVISION D.—Section 1. Clothing.

Anatomical Boots.

Certificate of Merit, 1889; Medal, 1892.

To Nathaniel Bletchly.

Description.—The Boots are designed to fit the natural shape of the feet, and are noiseless.

Prices.—From £1 2s. Directions for self-measurement on application.

Manufactured by Nathaniel Bletchly, 89, Northgate Street, Gloucester.

Cellular Clothing.

Medal, 1889.

Cellular Fabrics.

Medal, 1890.

To The Cellular Clothing Co.

Description.—The Fabric is made so that the outside presents an open Cellular appearance, while the reverse side is more closely woven. The material being porous, retains a film of warm air around the body, and at the same time allows the excretions to pass off from the skin. It is made in Cotton, Merino, Wool, or Silk.

Prices.—Shirts, 5s. 6d. to £1 5s.; Pyjamas, £1 6s. to £2 12s.

Manufactured by The Cellular Clothing Co., 124, London Wall, E.C.

DIVISION D.—**Section 1.** *(Continued.)*

Sanitary Hat Linings.

Certificates of Merit, 1889 and 1890.

To D. W. Wall.

Description.—The Lining suspends the Hat. A larger surface than usual being in contact with the head, weight is distributed and therefore less at any given point. The forehead, the part unprotected by a cushion of hair, is relieved of all pressure.

Prices.—From 5s. 6d. upwards.

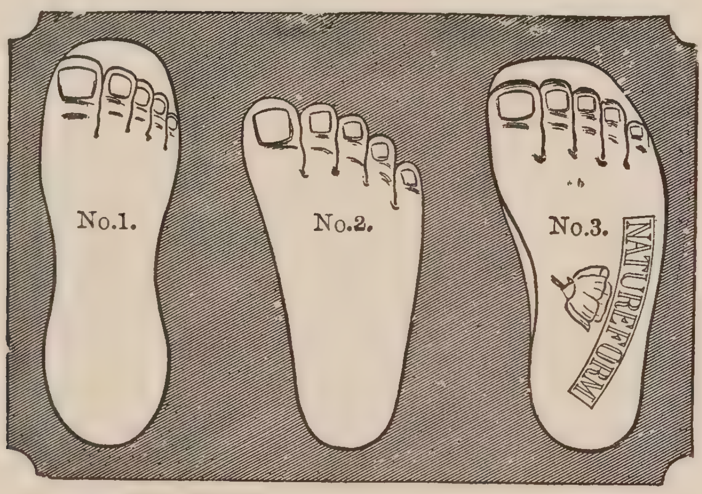
Manufactured by D. W. Wall, 2, Camberwell Gate, S.E.

DIVISION D.—**Section 1.** *(Continued.)*

Nature-form Boots and Shoes for Children.

Certificate of Merit, 1892.

To HOLDEN BROS.



No. 1—"Straight" Shoe, as commonly worn. No. 2—A Natural Foot of a Child.
No. 3—"Nature-form" Shoe.

DESCRIPTION.—These are made upon the lasts corresponding exactly to the natural form of the foot, and in four different widths to each length, thus ensuring a fit whether the foot is broad or narrow.

PRICE.—From 3s.

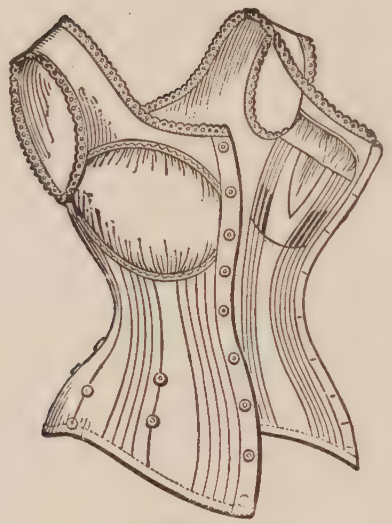
Manufactured by HOLDEN BROS., 223 & 223A, Regent Street, W.

DIVISION D.—**Section 1.** *(Continued.)*

Hygienic Corsets.

Certificate of Merit, 1892.

To Herts, Son & Co.



Description.—A Corset and Bodice combined (known as the Platinum Anti-Corset), fitted with unbreakable bones, so arranged that all are removable for washing. In cotton, pure wool, Turkey red, and other materials.

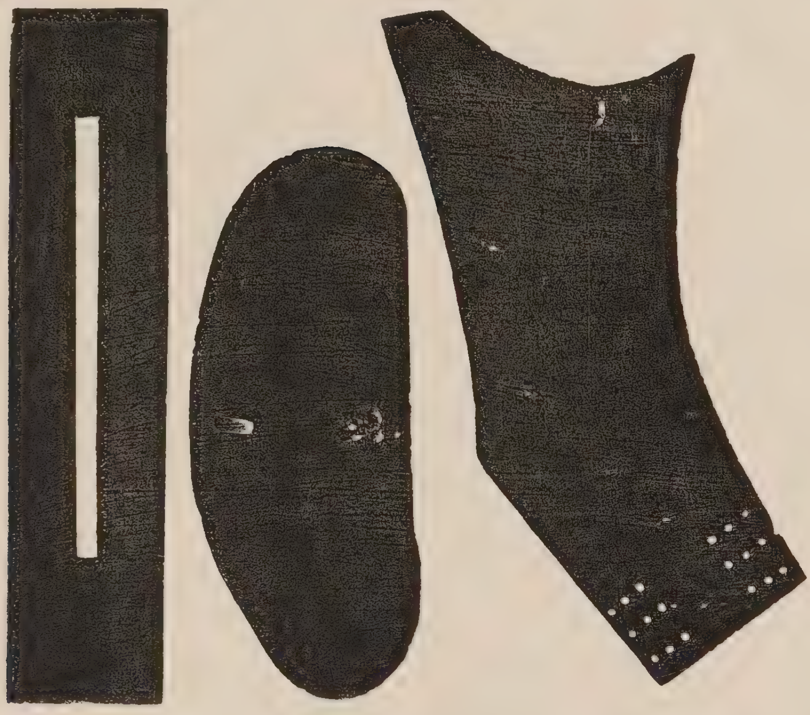
Price.—From 6s. 11d.

Manufactured by Herts, Son & Co., Limited, Ridgmount Street, W.C.

System of Hygienic Dress Cutting.

Certificate of Merit, 1892.

To F. H. Knights.



Description.—The pattern for the Bodice is made in three pieces called Scale used for straight lines only, and has on it calculations for Back on one side and for Front on the other, and the Chart which represents all the curves required are used with it. The Sleeve Chart has on its right side the top part of sleeve, and on the left side the under position. The System also includes a Skirt Cutter, which is suitable for designing twelve different styles of skirts. The material of which the Charts are made is unbreakable.

Price.—10s. 6d. for complete System, including Book of Instructions.

Manufactured by Knights' European Dress Cutting Association, Reading.

Men's India Rubber Boots Ventilated and Lined with Felt.

Certificate of Merit, 1892.

To J. J. Thornton & Co.

Description.—These India Rubber Boots are ventilated by means of tubes down the sides and about the feet. They are made without seams.

Sizes.—In all sizes.

Price.—25s. per pair.

Manufactured by J. J. Thornton & Co., Southsea and Brighton.

DIVISION D.—Section 2. Beds and other Furniture.

Exhibit of Church Fittings.

Certificate of Merit, 1890.

To G. M. Hammer & Co.

Description.—Lecterns, Altar Tables, Pulpits, Church Seatings, Prayer Desks, Reading Desks, Vestry Fittings, Brass Work Fabrics, &c.

Manufactured by G. M. Hammer & Co., 370, Strand, W.C.

Down Covered Air Cushions.

Certificate of Merit, 1892.

To J. J. Thornton & Co.

Description.—These Cushions are an improvement upon the old style of airproof Cushions, being made or covered in fancy materials, and also having a covering of down.

Sizes.—Made in all sizes and shapes.

Prices.—From 10s. 6d.

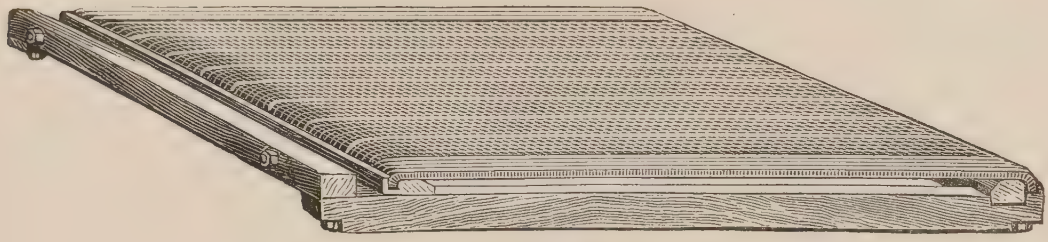
Manufactured by J. J. Thornton & Co., India-Rubber Manufacturer, Southsea and Brighton.

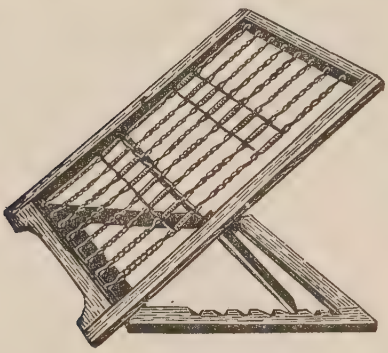
DIVISION D.—Section 2. *(Continued.)*

Wire Mattresses and Adjustable Bed Rests.

Certificate of Merit, 1890.

To Walter Walker.





Description.—The tension of the web is alterable at will, by tightening or slackening the adjustable screws. The Mattress can be quickly taken to pieces for shipment or removal.

Sizes.—3 ft. to 5 ft.

Prices.—From 12s. 6d. to £1 6s. 6d.

Manufactured by Walter Walker, Grambian House, 163, 164, 165, Western Road, Brighton.

Bath Chair.

Certificate of Merit, 1890.

To J. L. Brigden & Co.

Description.—Suitable for sitting or lying posture, Spring Back and Cushion; for drawing by Hand, Donkey, or Pony.

Price.—For Hand-drawing, £52 10s. Shafts and Bar for Donkey or Pony, £2 2s.

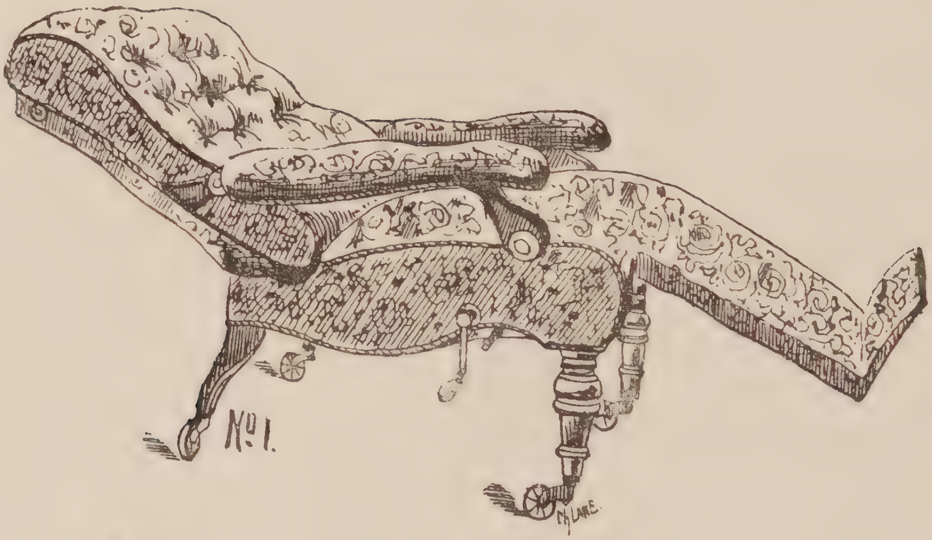
Manufactured by J. L. Brigden & Co., 187, Western Road, Brighton.

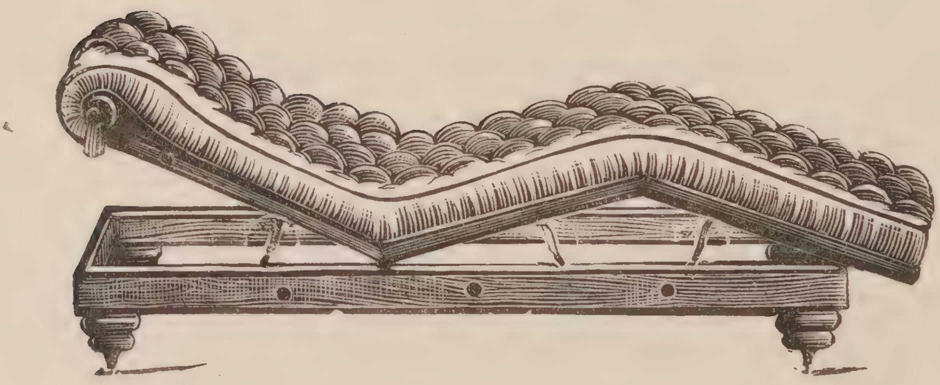
DIVISION D.—Section 3. Hospital and Sick Room Appliances.

Excelsior Adjustable Invalid Chair and Couch.

Certificate of Merit, 1890.

To J. Mills.





Prices.—From £9 to £15.

Manufactured by J. Mills, 24, North Road, Brighton.

Crutch with Side Handle.

Certificate of Merit, 1890.

To E. A. B. Beaumont.

DIVISION D.—Section 3. *(Continued.)*

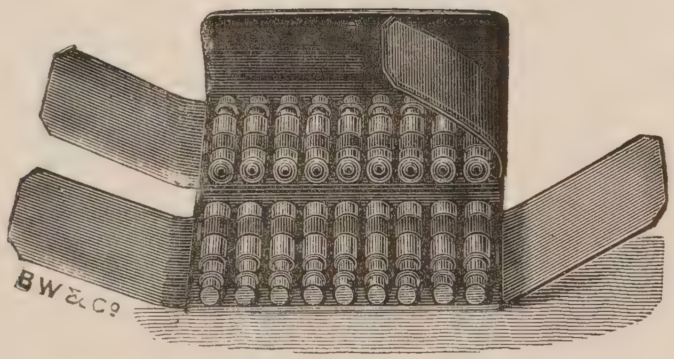
Medicine Chest and Pocket Cases.

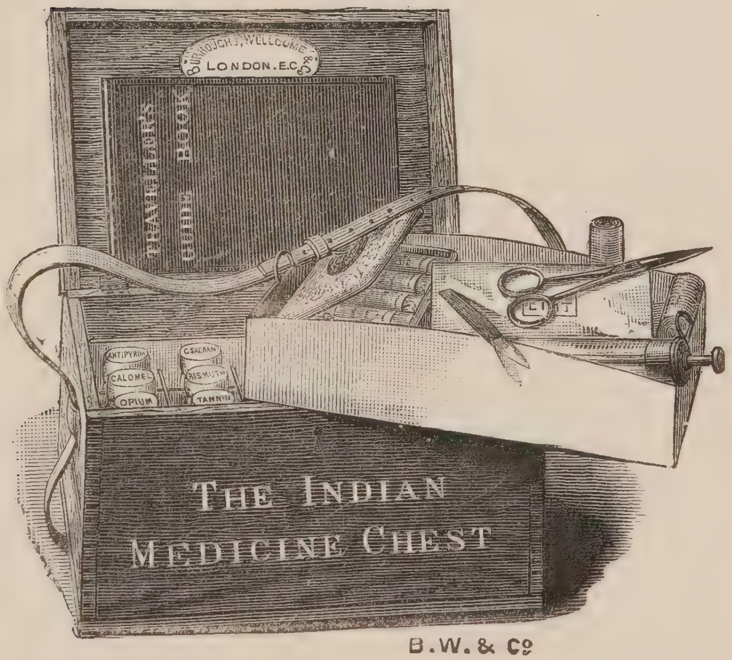
Certificate of Merit, 1890.

Travelling Medicine Chests.

Medal, 1892.

To Burroughs, Wellcome & Co.





Description.—The "Indian" Medicine Chest is made of matured teak wood, fitted with metal trays, and contains a supply of medicines.

Prices.—B. W. & Co. Calf-covered Pocket Case, containing sixteen ½-oz. vials, from 20s. each; "Indian" Medicine Chest, fitted with 20 × 2 oz. Stoppered Bottles only, £1 15s., retail; ditto, complete with Medicines, Instruments, and Guide Book, &c.. from £3 15s., retail; B. W. & Co. "Antidote" Case, £3 3s.; B. W. & Co. Urinary Test Case, £2; "Congo" Medicine Chest, without medicines, £3 5s., retail; "Livingstone" Medicine Chest, from £2 each.

Manufactured by Burroughs, Wellcome & Co., Snow Hill Buildings, E.C.

DIVISION D.—Section 3. *(Continued.)*

Surgical Dressings.

Medal, 1889.

To The Liverpool Lint Co.

Description and Use.—*Lints* for Surgical Purposes, manufactured from Flax and Cotton Yarns, absorbent, pure, and tearable. *Bandages* in open porous material, both grey and bleached, absorbent, and of close heavy cloth. Cotton Wools, absorbent, bleached, and grey. Surgeon's Tow, Carbolised Tow, an antiseptic dressing. Splint Padding, a combination of tow and absorbent wool. Protective Lint—ordinary Lint having attached a waterproof backing.

Manufactured by The Liverpool Lint Company, Mark Street Mills, Liverpool.

Prepared China Grass for Surgical Purposes.

Certificate of Merit, 1889.

To The Liverpool Lint Co.

Description.—A vegetable fibre possessing natural absorbent properties in excess of any absorbent power that can be given to cotton fibre.

Manufactured by The Liverpool Lint Company, Mark Street Mills, Liverpool.

DIVISION D.—Section 4. Domestic Appliances.

Hygienic Dust Bin.

Certificate of Merit, 1889.

To Henry Dean.

"Bland" Copying Machine.

Certificate of Merit, 1889.

To W. Bland & Co.

Manufactured by W. Bland & Co., Highfield Works, Leicester.

Venetian Blind Fittings.

Certificate of Merit, 1890.

To Smith, Collier & Co.

Description.—These Fittings dispense with the ordinary fixed head-piece, and can be removed easily. They can be re-laddered or re-corded without unscrewing.

Price.—2s. 6d., consisting of 3 Polished Brass Pulley-Wheels, 2 Brass Slotted Brackets and Steel End-Caps.

Manufactured by Smith, Collier & Co., 29, Aldermanbury, E.C.

China Slop Pails.

Certificate of Merit, 1890.

To J. Haines, Brighton.

DIVISION D.—Section 4. *(Continued.)*

Embroidery Machine.

Certificate of Merit, 1890.

To A. Williams.

Excelsior Dust Chute.

Certificate of Merit, 1890.

To J. Smeaton, Son & Co.

Description.—On the Chute being opened for the purpose of receiving ashes, all connection with the Ash Flue is shut off; no dust can escape, owing to draught or other causes, or in cases of ashes being deposited from Chutes connected with the same flue, placed in upper or lower rooms. Made of cast-iron, the door being sealed when shut with a rubber flange on front.

Prices.—Large, 18s. 6d.; Small, 15s. 6d.; Special, suitable for Artisans' Dwellings, 12s. 6d.

Manufactured by J. Smeaton, Son & Co., 56, Great Queen Street, W.C.

Model Working Dairy.

Certificate of Merit, 1889.

To Miss McCleod Spooner, Worcester.

Model Dairy.

Medal, 1890.

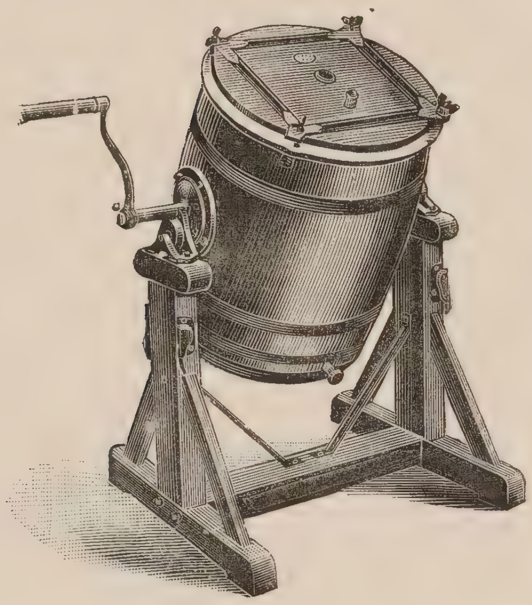
To Arthur Dann.

Description and Use.—Cream separating by centrifugal force; the Jersey Creamer; Churning Butter; Working same, and weighing and making up; Cream Cheese making.

Victoria Churn.

Certificate of Merit, 1890.

To Arthur Dann.



Description.—This Churn is in the form of a barrel, without heaters either fixed or movable, and revolves over end ways. The entire end of the Churn forms the lid; hence, there are no corners out of sight, and it is easy to keep it clean. Set into the lid is a glass window which admits of the contents inside the Churn being seen, thereby preventing overchurning.

Sizes.—	2,	3,	4,	6,	9,	12 Gallons.
Prices.—	£2 10s.	£3	£3 10s.	£4 5s.	£4 15s.	£5 5s.

Manufactured by Dairy Supply Co., Museum Street, London, W.C.

Arctic Freezer.

Certificate of Merit, 1892.

To Arctic Freezer Syndicate.

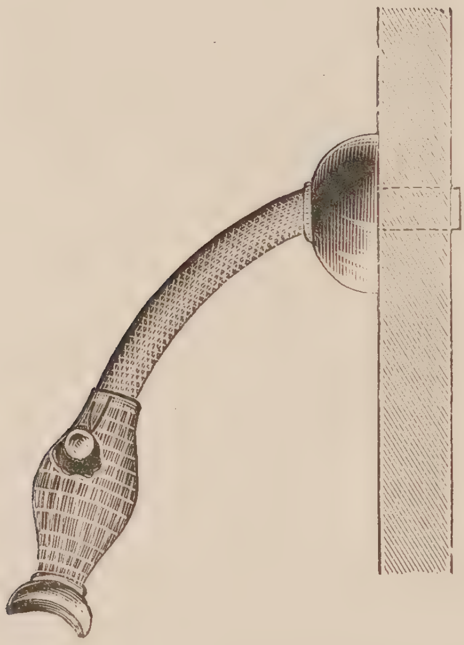
Description.—Consists of a cylinder containing ice, which dips into a shallow saucer containing cream or syrup. As the cylinder is revolved it carries away some of the syrup, which freezes on to its surface, and is removed by a scraper before that part of the surface again reaches the syrup. The syrup is slowly poured in, to supply the quantity taken up by the cylinder.

DIVISION D.—Section 4. *(Continued.)*

Black's Signalling and Speaking Tube Apparatus.

Certificate of Merit, 1889.

To R. W. Tomlinson.



Description.—The Speaking Apparatus and Bell are combined in one. It can be used as a Signal Bell only, or as a Speaking Tube. By pressing the india-rubber ball at the mouthpiece a bell is rung at each end of the Tube. When the mouthpiece is lifted a little valve falls out of the seat or neck of the mouthpiece, and the Tube is clear for speaking.

Prices.—10s. 6d. and 15s. 6d. each end. With Indicator, 1s. 6d. extra.

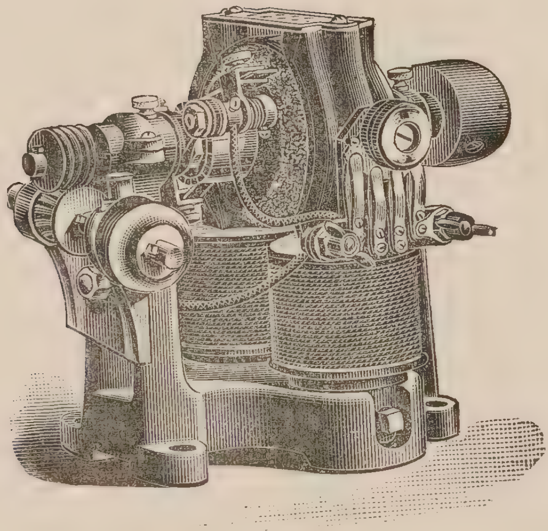
Manufactured by Baxendale & Co., Miller Street, Manchester.

DIVISION D.—Section 4. *(Continued.)*

Domestic Motor.

Medal, 1892.

To Crompton & Co., Limited.



Description.—The Electro-motor is a little machine made on the principle of the dynamo, but instead of *producing* currents of electricity, it *uses* them. Thus electricity on being passed to the Motor causes it to work, and the armature rotating at considerable speed gives out power. Sewing machines, boot cleaning machines, polishers, ventilators, pumps, coffee grinders, hair brushing machines, and a multitude of other applications of mechanical power may be used in combination with the electro-motor.

Sizes.—$\frac{1}{12}$ to any size.

Prices.—From £7 10s.

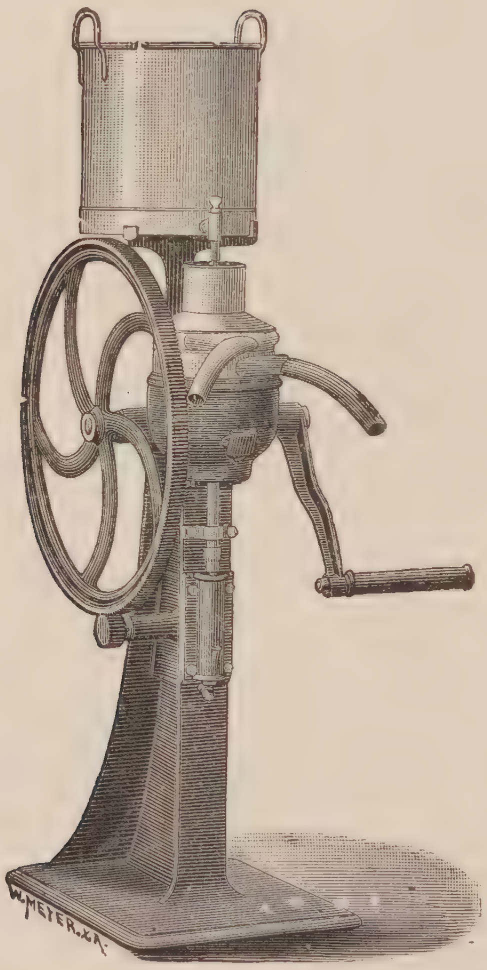
Manufactured by Crompton & Co., Limited, 148, Brompton Road, S.W., Queen Victoria Street, E.C., and Chelmsford.

DIVISION D.—Section 4. *(Continued.)*

Alpha Cream Separator.

Medal, 1892.

To North Wilts Dairy Co.



Description.—This machine is fitted with Alpha improvements.

Price.—Hand power, separates 65 gallons per hour, complete, £29.

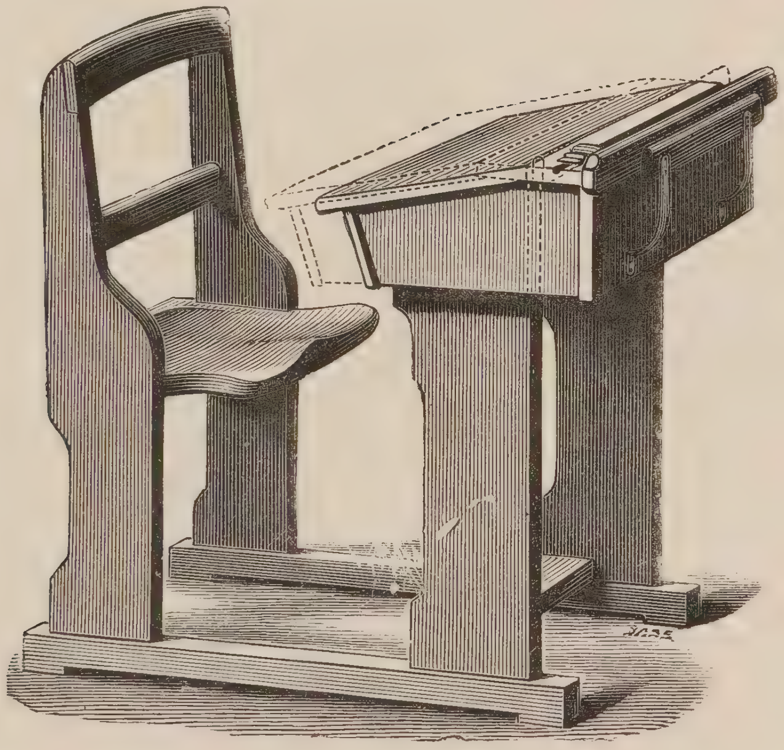
Sold by The Dairy Supply Co., Limited, Sole Agents, 28, Museum Street, London.

DIVISION D.—Section 5. School Fittings.

School Furniture.

Medal, 1890.

To G. M. Hammer & Co.



Description.—The "Louise" Single Desk is fitted with Metal Runners, on which the Desk slides backwards and forwards, allowing ample room for ingress and egress, and yet when drawn close to the scholar preventing stooping, and having a comfortably shaped back to the seat, securing a healthy position of the body. Many other kinds of Desks, including Convertible Desks, forming Tables, Seats, &c., and all kinds of School apparatus.

Sizes.— 31 in., 33 in., 35 in.

Prices.—Varnished deal, £1, £1 1s., £1 2s.

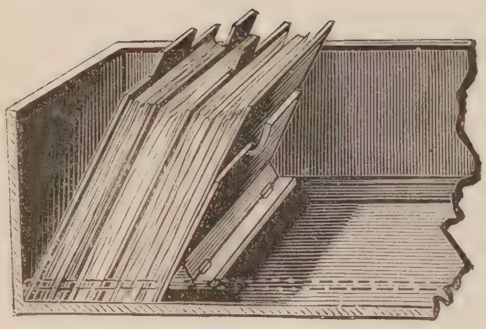
Manufactured by G. M. Hammer & Co., Strand, W.C.

DIVISION D.—Section 5. *(Continued.)*

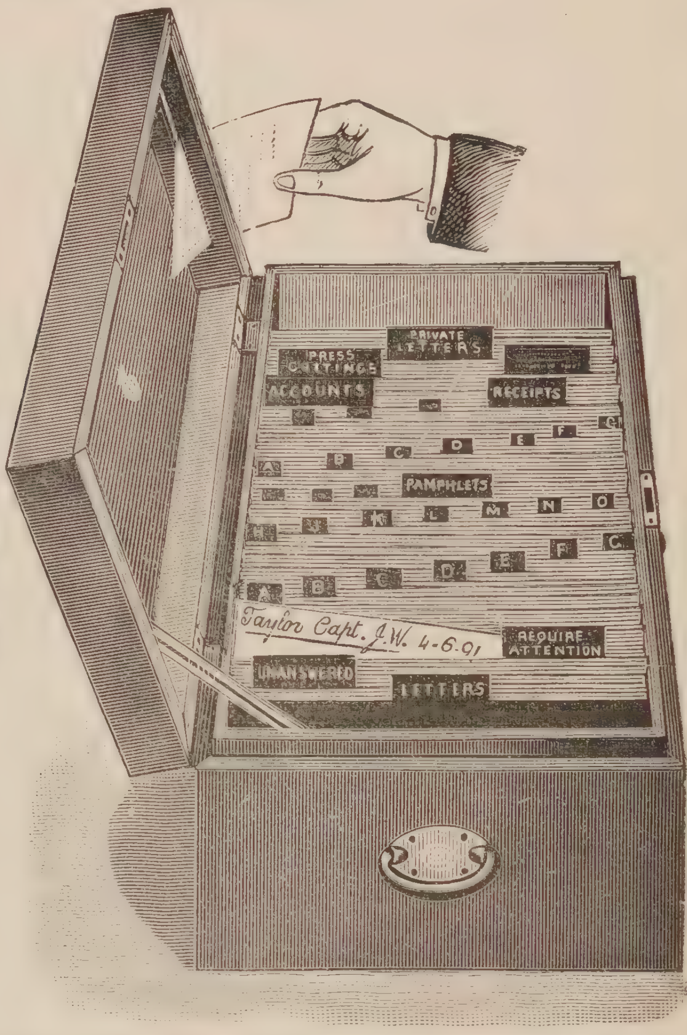
The "Ceres" Automatic Letter and Card File Cabinet.

Certificate of Merit, 1892.

To T. Bowater Vernon, the Inventor and Patentee.



Section Showing Automatic Sliding Support.



No. 1 Letter File. Dimensions $20 \times 12 \times 9\frac{1}{2}$ in. high.

Description.—A method of keeping Letters and Documents; also Card Files with Automatic Slide, with or without the rod, for indexes, lists, &c. The system is worked in File Boxes, Cabinets of Drawers, Writing Tables, or other receptacles, the Letters being arranged, standing up, at a convenient slope against a sliding support. The order of arrangement may be either alphabetical or numerical, or blank headings can be supplied to suit individual requirements.

Prices.—In Wood (covered cloth)—No. 1, for 2,000 Letters, £1 5s. 6d. No. 2, 1,000 Letters, 17s. 6d.; Yale Lock (unpickable), 4s. 6d. extra. Some twenty other patterns are made with capacity up to 25,000 Letters in a single alphabet.

Full Descriptive Catalogue, with suggestions as to keeping papers and utilising the Card System, on application.

Manufactured by T. Bowater Vernon, Albany Buildings, 39, Victoria Street, S.W.

DIVISION D.—Section 6. **Gymnastic Appliances.**

"Harrow" Safety Bicycle.

Certificate of Merit, 1890.

To HALLIWELL & Co.

DESCRIPTION.—Each Machine weighs, with Saddle and Pedals, from 36lbs. to 40lbs. 26 inch Driving-Wheel, 28 inch Steering-Wheel, Warwick's Rims, Ball Bearings throughout, including Head and Pedals, $1\frac{1}{4}$ inch Cushion, Tyres with $\frac{1}{4}$ inch hole, Brighton Adjustable Spring Footrests, "Harrow" Steering Lock, Bottom Bracket with Bearings outside of Chain Wheel; Band-Brake on Crank-Axle.

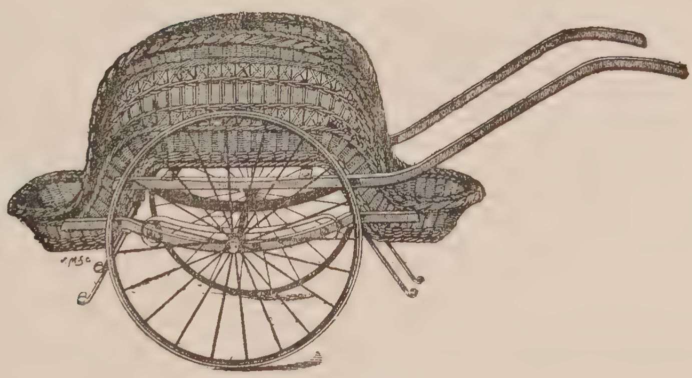
SIZE.—Geared, 58 in.

PRICES.—£21 15s.; Boothroyd Pneumatic Tyres, £1 10s. extra. Dunlop Pneumatic Tyres, £3 15s. extra.

Wicker Mail Cart.

Certificate of Merit, 1890.

To HALLIWELL & Co.



PRICE.—£3 7s. 6d.

Manufactured by HALLIWELL & Co., Pool Valley, Brighton.

Florador Food.

Certificate of Merit, 1889.

To McLean & Son, Edinburgh.

Description.—It is made from Wheat by a special process, whereby the nutritious parts are presented in a granular form.

Sizes.—$\frac{1}{4}$ lb., $\frac{1}{2}$ lb., 1 lb. packets.

Prices.—$1\frac{1}{2}$d., 3d., 6d.

Manufactured by Florador Food Company, 19, Washington Street, Glasgow.

Frame Food Extract.

Certificate of Merit, 1889.

To Frame Food Company, Limited.

Description.—The nutritious matter is extracted from Wheat Bran by a mechanical (not chemical) process. The Extract is supplied in the form of a fine powder for adding to Bread Flour (1 oz. Extract to 5 lbs. flour), Corn Flour, Cocoa, and all farinaceous food stuffs; also to soups, gravies, &c. It is the specially nutritive feature in "Frame Food" Diet.

Sizes.—$\frac{1}{4}$ lb., $\frac{1}{2}$ lb., 1 lb. Tins.

Prices.—10d. 1s. 6d. 2s. 10d.

Manufactured by Frame Food Company, Limited, Lombard Road, Battersea, London, S.W.

DIVISION D.—Section 7. *(Continued).*

Preserved Fruits.

Medal, 1889.

To Vale of Evesham Fruit Preserving Co.

Packed in Glass Bottles.

Manufactured by Vale of Evesham Fruit Preserving Co., Pershore.

Cocoa.

Certificate of Merit, 1889.

Cocoa Essence.

Certificate of Merit, 1892.

To Cadbury Bros.

Manufactured by Cadbury Bros., Birmingham.

Edwards' Desiccated Soup.

Certificate of Merit, 1889.

To Frederick King & Co.

Made by Frederick King & Co., Belfast.

Case showing the Relative Constituents of Various Milks.

Certificate of Merit, 1890.

To Edward Wyborn.

DIVISION D.—Section 7. *(Continued.)*

Currie Powder and Paste.

Certificate of Merit, 1890.

To J. Edmunds.

Description.—"The Empress" Currie Powder is prepared from an old Indian recipe, with Oriental seeds, spices, etc. "The Empress" Currie Paste is also prepared from an old Indian recipe, with Indian and other fruits amalgamated with the "Empress" Currie Powder. It is used in dishes of Currie to give a piquant flavour.

Prices.—1d. Packets; 4d., 6d., 1s., 1s. 6d., 2s. 6d., Bottles; 1lb., 4lb., 7lb., 14lb. 28lb., Tins; 1 cwt. and 2 cwt. Casks.

Manufactured by Joseph Edmunds, "Empress" Indian Condiment Warehouse, Belper Street, Barnsbury, N.

Germ Bread and Flour.

Certificate of Merit, 1890.

To J. J. Clark.

Description.—"Germ Flour" consists of the separated Germ of Wheat, partly cooked by the action of super-heated steam, and then mixed with fine wheat flour. The Bread is prepared from the Flour by a process of rapid fermentation, which ensures the retention of the flavour. From "Germ Flour" is prepared a Yellow Bread. It is also suitable for making into Biscuits, Scones, and Infants' Food.

Size.—Made in ordinary loaf and biscuit sizes.

Prices.—Sold at same price as "best" bread.

Manufactured at J. J. Clark, Goldstone Bread Factory, Brighton.

Assam Tea.

Certificate of Merit, 1890.

To The Meta Cha Tea Company.

Prices.—From 2s. per pound.

Manufactured by The Meta Cha Tea Co., Dibrugart, Assam.

Essence of Beef.

Certificate of Merit, 1890.

To H. K. Edge.

Description.—Essence of Beef is made from meat juice, without the addition of water, gelatine, or any other extraneous substances. It is put up in bottles instead of tins, and does not come into contact with metal.

Prices.—In Bottles, 2s. 6d. and 3s. 6d. respectively.

Manufactured by H. K. Edge, Farringdon Road, E.C.

Rizine Food.

Certificate of Merit, 1890.

To Rizine Food Company, Limited.

Description.—Rice of a special kind is subjected to a high, moist temperature, and afterwards dried and pressed into flaky shapes by means of hot cylindrical rollers. This process partly cooks the Rice and removes a portion of the excessive starchy element.

Size.—1 lb. packets.

Price.—6d. each.

Manufactured by Rizine Food Company, Limited, 87, Borough High Street, S.E.

DIVISION D.—**Section 7.** *(Continued.)*

Meat Preparation.

Medal, 1890.

Beef Essences.

Medal, 1892.

To Brand & Company.

Description.—Specialties for Invalids, consisting of Essences of Beef, Mutton, Veal and Chicken, Concentrated Beef Tea and other Broths, Savoury Meat Lozenges, Turtle Soup and Jelly, Calf's Foot Jelly, Albuminous Extract of Beef.

Manufactured by Brand & Company, Mayfair.

Improvements in Bread Making.

Medal, 1890.

To J. J. Clark.

Description.—These Improvements consist essentially in the building of a large factory, specially designed for the manufacture of Bread and Confectionery, which is fitted throughout with ovens and machinery of approved kind.

Manufactured by Clark's Bread Factory, West Brighton.

Delft Rye Yeast.

Medal, 1890.

To A. Barham.

Manufactured by Delft Rye Yeast Co., Delft.

Coffee Extract.

Certificate of Merit, 1892.

To E. Clark & Co.

Sizes.—3 oz., $6\frac{1}{2}$ oz., 13 oz., 27 oz. bottles.

Prices.—6d., 1s., 2s., and 4s.

Manufactured by E. Clark & Co., Queen's Road, Battersea.

Malt Extracts.

Certificate of Merit, 1892.

To Burroughs, Wellcome & Co.

Description.—Kepler Extract of Malt, made from barley. Kepler Solution of Cod Liver Oil in Malt Extract. The Kepler Essence of Malt: This is a liquid preparation of about the same consistency as glycerin, and is virtually a saturated solution of diastase and the natural phosphates as existing in barley malt.

Sizes.— $\frac{3}{4}$ lb. and $1\frac{1}{2}$ lb.

Prices.—2s. 6d. and 4s

Manufactured by Burroughs, Wellcome & Co., Snow Hill Buildings, E.C.

Corn Flour.

Medal, 1892.

To Brown & Polson.

Description.—Manufactured from maize by a process patented by them, and which is designed to secure the absence from it of the oil and fatty matter, and render it essentially the same in all respects as arrowroot.

Price.—Lists to be had on application.

Manufactured by Brown & Polson, Royal Starch Works, Paisley, N.B.; 99, Queen Victoria Street, London, E.C.

DIVISION D.—Section 7. *(Continued.)*

Vegetable Seeds.

Medal, 1892.

To Sutton & Sons.

Manufactured by Sutton & Sons, Reading.

"Mosquera" Beef Meal.

Medal, 1892.

To Mosquera-Julia Food Co.

Description.—Mosquera's Beef Meal is a desiccated Powdered Beef, artificially digested by aid of certain vegetable ferments.

Size.—In ½ lb. packages or bulk.

Price.—2s. 6d. per ½ lb. package.

Manufactured by Mosquera-Julia Food Co., Detroit, U.S.A., and 21, North Audley Street, W.

Mazawattee Ceylon Tea.

Certificate of Merit, 1892.

To Mazawattee Ceylon Tea Company.

Prices.—From 1s. 10d. per lb.

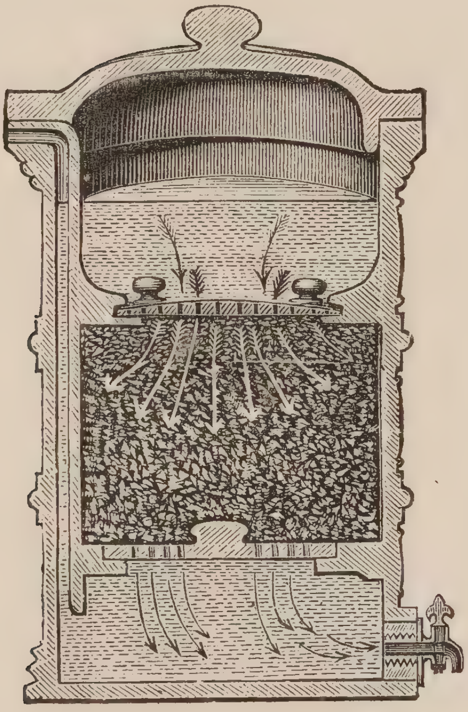
Manufactured by Mazawattee Ceylon Tea Co., 49, Eastcheap, E.C.

DIVISION D.—**Section 8. Domestic Filters.**

Cheavin's Water Filter, with Removable Plate.

Certificate of Merit, 1889.

To J. WARD & SON.



DESCRIPTION.—The Removable Plate Filters can be taken to pieces, cleansed (leaving the whole of the interior open for inspection), and re-charged with new Idiocathartes. Nothing comes in contact with the water but Stoneware and the new Idiocathartes and Asbestos.

SIZES.—$\frac{1}{2}$ Gallon to 36 Gallons.

PRICES.—11s. 6d. to £7 3s.; re-charges, from 1s. 6d. to £1 1s.

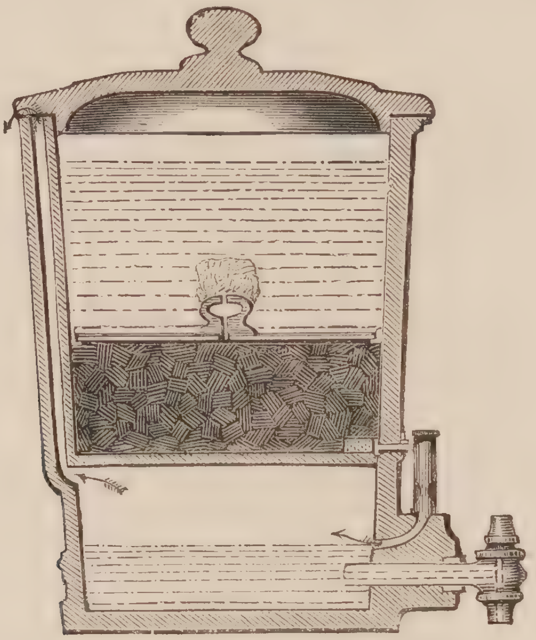
Manufactured by THE FULHAM POTTERY AND CHEAVIN FILTER CO., LIMITED, Fulham, S.W.

DIVISION D.—Section 8. *(Continued.)*

Bond's Regulating Filter.

Certificate of Merit, 1889.

To The Sanitary and Œconomic Association, Limited.



Description.—Consists of an Earthenware Jar, divided into two unequal sized Chambers by a slate diaphragm cemented in. The upper Chamber is partly filled with the filtering material "Carferal." A perforation in the earthenware is made in the lower portion of the upper chamber, and a corresponding perforation is also made in the lower chamber. An aluminium tube connects the two chambers, and is fixed externally, having one end placed through each perforation, the tube being fitted with a regulating tap, which governs the rate of flow and filtration. A glass in the tube permits the flow to be seen.

Sizes.—2 and 4 Gallons.

Prices.—From 18s. 6d.

Manufactured by The Sanitary and Œconomic Association, Limited, Gloucester.

DIVISION D.—**Section 8.** *(Continued.)*

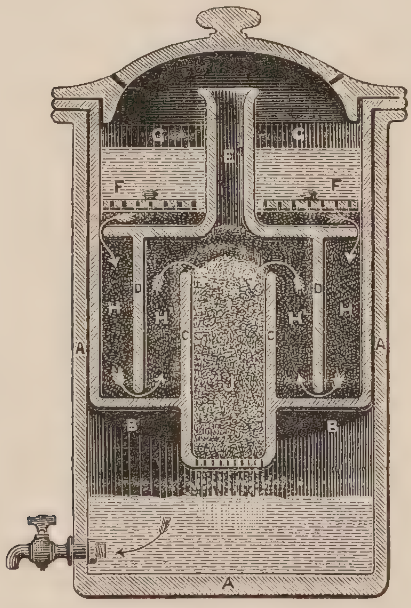
Circulating Arrangement for Filters.

Certificate of Merit, 1890.

Morris Circulating Principle of Water Filtration.

Medal, 1892.

To The Morris Tube Ammunition Co.



Description.—The Filter is arranged with Vertical Annular Divisions, so that the water has to pass through a large quantity of the filtering material in the directions indicated by the arrows in the drawing.

Sizes.—From 2 Quarts to 12 Gallons.

Prices.—From 14s. to £4 10s.

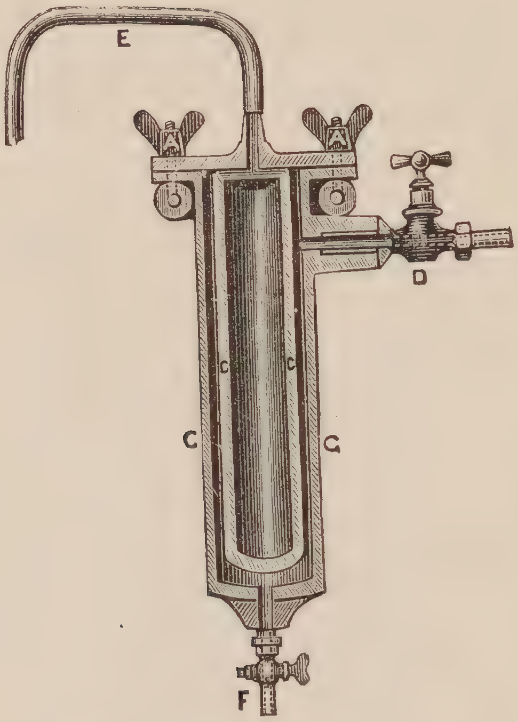
Manufactured by The Morris Tube Ammunition Co., 11, Haymarket, S.W.

DIVISION D.—**Section 8.** *(Continued.)*

Berkefeld Filter.

Certificate of Merit, 1892.

To Berkefeld Filter Co.



Description.—This Filter consists of Cylinders made from Fossil Earth obtained from Kieselguhr mines in Hanover. The Cylinders can be burned or boiled at any time to ensure a complete purification and sterilisation. House Filter, style H, to attach to supply pipe; specially designed for household purposes; made of cast iron, bronzed, and enamelled inside; taps and fittings nickel-plated. These Cylinders are made in two sizes, Candle A (8 in. by 1 in.) specially designed for laboratory use, and Candle B ($10\frac{1}{4}$ in. by 2 in. diam., $1\frac{1}{4}$ in. bore), giving an actual filtering surface of half a square foot, and capable of filtering six hundred gallons of water a day under a pressure of forty-five pounds.

Sizes.—Height, 18 in. Diameter, 3 in.

Price.—£2 2s.

Manufactured by The Berkefeld Filter Co., Limited, 121, Oxford Street, W.

DIVISION D.—Section 8. *(Continued.)*

Porcelain Screw Tap for Filters.

Certificate of Merit, 1892.

To C. E. Gittens, Limited.

Description.—This Tap screws directly into the earthenware of the Filter.

Manufactured by C. E. Gittens, Limited, 18, Paper Street, Redcross Street, E.C.

DIVISION D.—Section 9. Mineral Waters.

Mineral Waters.

Certificate of Merit, 1890.

To Shelvey & Co.

Prices.—Soda Water, 2s. 6d. per doz.; Lithia Water, 3s. per doz.; Seltzer Water, 3s. per doz.; Potass Water, 2s. 6d. per doz.

Manufactured by Shelvey & Co., Brighton.

Potash, Seltzer, and Soda Waters.

Certificate of Merit, 1892.

To C. Mumby & Co.

Manufactured by C. Mumby & Co., The Hard, Portsmouth.

DIVISION D.—**Section 9.** *(Continued.)*

Potash, Soda, Seltzer, and Lithia Waters.

Certificate of Merit.

To A. F. Perkins.

The above-named waters are available through town and country agents, in screw-stoppered, corked, and syphon bottles, at uniform prices: one quality is alone manufactured.

Manufactured by A. F. Perkins, Hyde Park Factory, Southsea.

DIVISION D.—**Section 10. Soaps and other Detergents.**

Carbolic Soaps.

Medal, 1889.

To F. C. Calvert & Co.

Prices.—Carbolic Toilet Soap, 6d. per Tablet; Carbolic "Anti-Mosquito" Soap, 6d. per Tablet; Carbolic Nursery Soap, 6d. per Tablet; Carbolic Shaving and Tooth Soap, 6d. and 1s. per Tablet or Stick; Carbolic "Prickly-Heat" Soap, 6d. and 1s. per Bar; Carbolic Domestic Soap, 6d. per 1lb. Bar; Carbolic Scouring Soap, 4d. per 1lb. Bar; Carbolic Soft Soap, 1s. and 2s. per 1-lb. and 2-lb. Jars.

Manufactured by F. C. Calvert & Co., Manchester.

Vinolia Soap.

Certificate of Merit, 1889; Medal, 1892.

To Blondeau et Cie.

Description.—A white Toilet Soap, neutral, milled and superfatted; the basis made with edible fats, and only pure essential oils used as scents.

Prices.—Premier, 4d; Floral, 6d.; Balsamic, 8d.; Toilet (Otto), 10d.; and Vestal, 2s. 6d. per Tablet. Shaving Soap: Sticks, 6d., 1s., 1s. 6d., and 2s. 6d. per Stick; Flat Cakes, 1s., 2s., and 3s.

Manufactured by Blondeau et Cie., Ryland Road, London, N.W.

DIVISION D.—Section 10. *(Continued.)*

Sunlight Soap.

Certificates of Merit, 1889 and 1890.

To Lever Bros.

Made by Lever Bros., Port Sunlight, Birkenhead.

Toilet Soaps.

Medal, 1889.

To Edward Cook & Co.

Description.—Savon de Luxe (made by a new process), and Toilet Soaps of every description; also Soap-Cream for infants and Shaving-Cream, scented, suitable for the Nursery and Toilet.

Manufactured by Edward Cook & Co., Soap Makers, London, E.

Primrose Soap.

Certificate of Merit, 1890.

To John Evershed & Son.

Description.—Made from "Tallow" and Alkali.

Manufactured by J. Evershed & Son, Brighton.

DIVISION D.—Section 10. *(Continued.)*

Lanoline, and Preparations containing it.

Certificate of Merit, 1890.

To BURROUGHS, WELLCOME, & CO.

DESCRIPTION.—"Lanoline" is a preparation of the fat obtained from sheep's wool, and being natural to the skin and hair, is absorbed by them at once.

PRICES.—"Lanoline," 1-lb. and 7-lb. Tins, any quantity, 2s. 8d. per lb.; "Lanoline" (Anhydrous), 1-lb. Tins, 3s. 4d. per lb.; "Lanoline" Ointment Base, 2s. 2d. per lb.; "Lanoline" Pomade, 1s. 6d. each; "Lanoline" Cold Cream, in Bottles, 1s. 6d. each; "Lanoline" Toilet Soap, from 6d. per Cake; Toilet "Lanoline," 6d. and 1s. each.

Manufactured by BURROUGHS, WELLCOME, & CO., Snow Hill Buildings, E.C.

Hydroleine.

Certificate of Merit, 1890.

To H. K. EDGE.

DESCRIPTION.—A Cleansing and Water-softening preparation in the form of Soap Powder.

PRICES.—16s. 9d. per cwt.; and in 1d. and 3d. Packets.

Manufactured by THE NEW HYDROLEINE CO., LIMITED, Ashby-de-la-Zouch.

DIVISION D.—Section 11. Antiseptics and Disinfectants.

Carbolic Acid Preparations.

Medals, 1889 and 1890.

Pure Carbolic Acid.

Medal, 1892.

To F. C. Calvert & Co.

Description.—No. 5 Concentrated Carbolic must be *well mixed* with water, in proportion of one ounce of Acid to two quarts of water; and forms a solution of sufficient strength for deodorising drains, stables, &c. and for cleansing rooms infested with insects.

Fifteen per cent. Carbolic Disinfecting Powder is an inert non-cohesive base, combined with fifteen per cent. of Genuine Carbolic in a free state.

Prices.—No. 5 Carbolic Acid, in ribbed Bottles, from 1s. to 6s. 6d. Fifteen per cent. Carbolic Disinfecting Powder, from 6d. to 1s. 6d.

Manufactured by F. C. Calvert & Co., Bradford, Manchester.

Jeyes' Perfect Purifier.

Certificate of Merit, 1889.

Jeyes' Fluid.

Certificate of Merit, 1892.

To Jeyes' Sanitary Compounds Co.

Description.—It is a mixture of such portions of Distilled Coal Creosote as contain the maximum of neutral basis and other antiseptic principles, used for disinfecting purposes. It is not poisonous, and can be mixed with water in any proportion.

Prices.—In Bottles, 6d. and 1s. each; 6s. per Gallon.

Manufactured by Jeyes' Sanitary Compounds Co., Limited, 43, Cannon Street, London, E.C.

DIVISION D.—**Section 11.** *(Continued.)*

Improvements in Pharmaceutical Preparations.

Medals, 1889 and 1890.

To Burroughs, Wellcome, & Co.

Prices.—"Tabloids" of Compressed Drugs—Beef and Iron Wine, 2s. 6d. per ½lb. Bottle, 4s. 6d. per 1lb. Bottle. Beef and Iron Wine with Quinine, 3s. per ½lb. Bottle, 5s. 6d. 1lb. Bottle. Kepler Extract of Malt, 2s. 6d. per ¾lb. Bottle, 4s. per 1½lb. Bottle. Kepler Solution of Cod Liver Oil in Malt Extract, from 2s. 6d. per Bottle. Pure Trypsin (Fairchild), 2s. per ¼oz., 6s. per 1oz. Hamamelis Virginica (Witch Hazel) Hazeline, 1s. 6d. per ¼lb. Bottle, 4s. 6d. 1lb. Bottle. Hazeline Cream (prepared with "Lanoline"), 1s. 6d. per 2oz. Pots. "Vaporoles," for Inhalation and Fumigation, 2s. 6d. per Box, retail.

Manufactured by Burroughs, Wellcome, & Co., Snow Hill Buildings, E.C.

St. Bede Disinfectant.

Certificate of Merit, 1889.

To St. Bede Chemical Co.

Description. — Perchloride of Mercury Mixture: By the use of Eucalyptus and Thymol the ozone-producing properties and perfume of these articles are obtained, while the risk of accident is reduced to a minimum by the solution being coloured dark blue, and by its containing a strong purgative in the form of Glauber Salts.

Sizes.—Small Boxes containing four Cubes, and large ones containing eight Cubes, each Cube capable of making 1 Quart of Disinfectant Solution equal to 1 in 1000 of Perchloride of Mercury.

Prices.—Small Boxes, 1s. each; and large size, 1s. 9d. each.

Manufactured by The Hedworth Barium Co., Limited, 1, St. Nicholas Buildings, Newcastle-on-Tyne.

DIVISION D.—**Section 11.** *(Continued.)*

Lano-Creolin.

Certificate of Merit, 1889.

To Burroughs, Wellcome & Co.

Description.—An Ointment containing 5 per cent. of Creolin (a non-poisonous substitute for Iodoform, Corrosive Sublimate, and Carbolic Acid.)

Size.—2 oz. Collapsible Metal Tubes.

Price.—1s. each.

Manufactured by Jeyes' Sanitary Compounds Co., Limited, 43, Cannon Street, London, E.C.

Preparation of Eucalyptol.

Certificate of Merit, 1890.

To J. Tucker & Company.

Prices.—Eucalyptus Disinfectant Fluid (A) in 4 oz., 1s. 6d.; 8 oz., 2s. 6d.; 16 oz., 4s. 6d. Bottles; and in ½ Gallon and 1 Gallon Tin Bottles. Eucalyptus Disinfectant Fluid (B) in 1 Pint 1s. Glass Bottles, and in ½ Gallon and 1 Gallon Tin Bottles. Eucalyptus Disinfectant Powder in 2lb. 1s. Tin Canisters.

Manufactured by J. Tucker & Company, 51, Paddington Street, W.

DIVISION D.—**Section 11.** *(Continued.)*

Preparations of Thiocamf.

Certificate of Merit, 1892.

To T. Tyrer & Co.

Description.—Liquid Combination of Sulphur Dioxide, Camphor, and some other Aromatic Disinfectants.

Sizes.—In Bottles.

Prices.—1s. and 2s.

Manufactured by Thos. Tyrer & Co., Stirling Chemical Works, Stratford, E.

Oxychlorogene.

Certificate of Merit, 1893.

To Mackey, Mackey & Co.

Description.—Prepared as a non-poisonous Deodorizer, Antiseptic, and Disinfectant.

Prices.—5s. per gallon; 10 gallons, 5 per cent. dis.; 20 gallons, 10 per cent. dis.; 100 gallons, 20 per cent. dis.

Manufactured by Mackey, Mackey & Co. 2, Bouverie Street, Fleet Street, E.C.

DIVISION D.—Section 11. *(Continued.)*

Kingzett's Mercuric Bactericide.

Certificate of Merit, 1892.

To Sanitas Co.

Description.—Five per cent. Mercuric Perchloride in a solution of Peroxide of Hydrogen of 5 vol. strength, and is preserved by Kingzett's patented process.

Prices.—In patent stoppered pint bottles, 2s. each; in bulk, 10s. per gallon.

Manufactured by The Sanitas Co. Limited, Three Colt Lane, Bethnal Green, E.

DIVISION D.—Section 12. Disinfecting Apparatus.

Disinfecting Sheet.

Certificate of Merit, 1892.

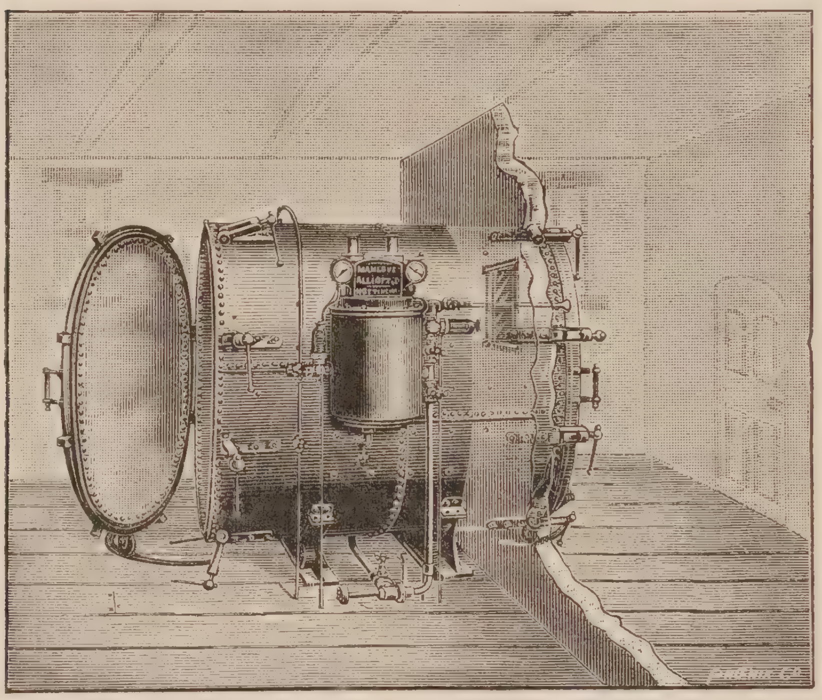
To Bugler & Co.

Manufactured by Bugler & Co., Putney.

Washington Lyon's Steam Disinfector.

Medals, 1889, 1890, and 1892..

To Manlove, Alliott & Co. (1889); and Washington Lyon (1890 and 1892).



Description.—The Apparatus consists essentially of a Steam Jacketted Disinfecting Chamber. The process of disinfection is performed in the Chamber by means of High Pressure Steam. Steam is also admitted into the Jacket, and as the Steam in the Jacket is always maintained at a higher temperature than the Steam in the Chamber, the latter is kept dry. The Valves and Fittings are all self-acting, so that steam is automatically admitted into both the Chamber and the Jacket at the required pressure. The Apparatus is strongly constructed of Iron or Steel Boiler-Plates, with strong Steel Ends capable of resisting the working pressure. The Fastenings are simple, and the Apparatus can be opened and closed very quickly, and is perfectly self-contained, requiring no brickwork setting. The usual arrangement is to have a Door at each end, each Door opening into a different room, so that the infected articles are placed in the Machine in one room, and the disinfected articles taken out into another room, and the two need not come in contact with each other, or disinfected articles be re-infected while being removed through a room in which infected articles have been placed.

Prices.—From £100 to £233.

Manufactured by Manlove, Alliott & Co., Limited, Engineers, Nottingham.

ALPHABETICAL LIST OF EXHIBITORS WHO HAVE RECEIVED AWARDS.

GENERAL INDEX.

LIST OF PLATES.

The Details of the Experiments referred to in Dr. Seaton's Report are as follows:—

The "St. Bede Disinfectant" was now in solution, one block being dissolved in one quart of water.

1.—The "killing power," i.e., the power to kill microbes, was tested on the following microbes: (A) bacillus anthracis without spores, (B) spores of bacillus anthracis, (C) the comma-bacillus found in Asiatic cholera, (D) the bacillus found in human typhoid fever.

Of normal cultivations in broth of these several microbes, about three drops were added to about three cubic centimetres of the disinfectant solution, well mixed, and after the lapse of five minutes, one to two drops of the mixture were added to tubes containing about 10 c.c. normal sterile beef broth; for control similar normal sterile beef broth was inoculated with a mere trace of the same culture fluids used for the above experiments. All broth tubes were placed in the incubator at 37° C., while all the control tubes showed already after twenty-four hours' copious typical growth of the several microbes, the others were perfectly clear and remained so afterwards. It follows from these experiments that five minutes' exposure of bacillus anthracis, of spores of bacillus anthracis, of the choleraic bacilli, and of the typhoid fever bacilli to the "St. Bede Disinfectant" solution is sufficient to kill these microbes.

2.—An important and extremely severe test of the killing power of the "St. Bede Disinfectant" solution was made in the following experiments:—

To normal human fœcal matter in thick solution, previously sterilised and contained in test tubes, was added a certain quantity of normal culture fluid of the choleraic bacilli and of the typhoid fever bacilli respectively, about one-seventh of the culture fluid being added to six-sevenths of the fœcal solution. After mixing well the disinfectant was added to each of the fœcal mixtures in equal proportions, so that each of the test tubes contained ½ of the fœcal matter plus culture fluid, and ½ of the disinfectant. After five minutes a number of test tubes containing sterile beef broth, as in the former series, were inoculated with a drop or two from these fœcal mixture tubes, then placed in the incubator and kept at 37° C., but no growth appeared in them and the fluids remained sterile. At the same time that the above experiments were made, control broth tubes were inoculated with a trace of the fœcal solution after the addition to them of the culture fluids, but before the addition of the disinfectant, these control tubes were also placed in the incubator and kept at 37° C., they all showed abundant normal growth after twenty-four hours of the choleraic bacilli and of the typhoid bacilli respectively.

(Signed) E. KLEIN, M.D., F.R.S.,
Professor of Bacteriology at the College of State Medicine, London.

Laboratory and Assay Office,
75, The Side, Newcastle-upon-Tyne,
July 6th, 1889.

I hereby certify that I have analysed a sample of the "St. Bede Disinfectant," manufactured by Messrs. The St. Bede Chemical Company (Limited), Newcastle-upon-Tyne, and that I find it contains as follows:—

Per-Chloride of Mercury	4·01 per cent.
Free Sulphuric Acid	4·10 ,,
Sulphate of Soda	87·25 ,,
Sulphate of Lime	1·30 ,,
Oxide of Iron, &c.	0·27 ,,
Chloride of Sodium	0·21 ,,
Insoluble Siliceous Matter	0·24 ,,
Thymol, Eucalyptus, Indigo, and Water	2·62 ,,
	100·00

The principal active ingredient of this disinfectant is Per-Chloride of Mercury (corrosive sublimate) which is known to be the most certain and powerful destroyer of disease germs. When the "St. Bede Disinfectant" is dissolved according to the instructions given it forms a solution of the strength and character recommended by Dr. Buchanan, the Medical Officer of the Local Government Board, as being effective as a disinfectant. It is prepared and packed in a form which makes it convenient and easy to be used.

(Signed) JOHN PATTINSON, F.I.C., F.C.S.
Public Analyst for Newcastle-upon-Tyne.